FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

Technical Memoranda

Prepared for

Transportation Development Centre
Transport Canada

Prepared by

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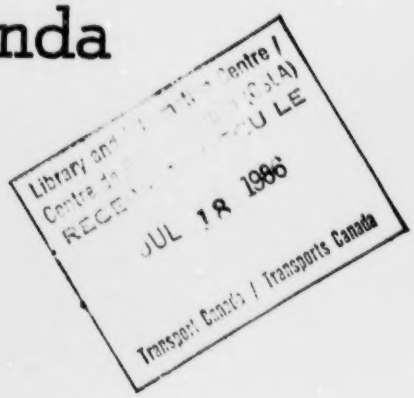
Transport Canada Development
Transports Canada Développement
Canada

Final Report

TP7009E

FREEWAY MANAGEMENT SYSTEMS FOR TRANSPORTATION EFFICIENCY AND ENERGY CONSERVATION

Technical Memoranda



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September 1985

D I S C L A I M E R

The contents of this report reflect the views of the contractor and not necessarily the official views of the Transportation Development Centre of Transport Canada.

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REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
TP 7009E	6084	

4. Title and Subtitle	5. Report Date
Freeway Management Systems for Transportation Efficiency and Energy Conservation: Technical Memoranda	September 1985
	6. Performing Organization Report No.

7. Author(s)	8. Transport Canada File No.
Jouko A. Parviainen (Jouko A. Parviainen & Associates) Walter M. Dunn, Jr. (Dunn Engineering, P.C.)	D1465-426

9. Performing Organization Name and Address	10. DSS File No.
Jouko A. Parviainen & Associates 1125 Linbrook Road Oakville, Ontario Canada L6J 2L3	11SD.T8200-3-3550
	11. DSS or Transport Canada Contract No.
	OSD84-00028

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Transportation Development Centre (TDC) 200 Dorchester Blvd. West - West Tower, Suite 601 Montreal, Quebec H2Z 1X4	14. Sponsoring Agency Code

15. Supplementary Notes	16. TDC Project Officer
See also "Freeway Management Systems for Transportation Efficiency and Energy Conservation" TP 6220E & TP 6640E	Catherine Hirou

17. Abstract

This report provides summarized accounts of the following tasks undertaken as part of the project entitled "Freeway Management Systems for Transportation Efficiency and Energy Conservation":

- examination of freeway transportation in three metropolitan areas (Vancouver, Toronto and Montreal)
- meetings with operating agencies and tour of existing roadways in Montreal
- review of summary data provided by the agencies
- development of possible concepts for specific traffic surveillance and control systems in Montreal
- review of possible projects with government agencies
- preparation of final modifications to the selected project in Montreal
- development of cost estimates
- selection and definition of system components
- range of applicable freeway management techniques for Vancouver and Toronto
- identification of implementation steps for a typical freeway management system

18. Key Words	19. Distribution Statement
energy conservation, transportation system management, highway, freeway, traffic congestion, accidents.	Limited number of copies available on request from sponsoring agency.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified	144	Nil

TDC CDT 79-005

FORMULE DE DOCUMENTATION POUR RAPPORT

1. N° du rapport Transports Canada	2. N° de l'étude — CDT	3. N° de catalogue du destinataire
TP 7009E	6084	

4. Titre et sous-titre	5. Date du rapport
Freeway Management Systems for Transportation Efficiency and Energy Conservation: Technical Memoranda	septembre 1985
	6. N° du rapport de l'organisme exécutant

7. Auteur(s)	8. N° de dossier Transports Canada
Jouko A. Parviainen (Jouko A. Parviainen & Associates) Walter M. Dunn, Jr. (Dunn Engineering, P.C.)	D1465-426

9. Nom et adresse de l'organisme exécutant	10. N° de dossier — ASC
Jouko A. Parviainen & Associates 1125 Linbrook Road Oakville, Ontario Canada L6J 2L3	11SD.T8200-3-3550
	11. N° de contrat — ASC ou Transports Canada OSD84-00028

12. Nom et adresse de l'organisme parrain	13. Genre de rapport et période visée
Centre de développement des transports (CDT) 200 ouest, boul. Dorchester, Suite 601, tour ouest Montréal, Québec H2Z 1X4	14. Code de l'organisme parrain

15. Remarques additionnelles	16. Agent de projet — CDT
Voir également "Freeway Management Systems for Transportation Efficiency and Energy Conservation" TP 6220E & TP 6640E	Catherine Hirou

17. Résumé

Ce rapport rend compte des divers travaux qui ont été faits dans le cadre du projet intitulé: "Systèmes de gestion d'autoroutes visant à maximiser l'efficacité des transports routiers et les économies d'énergie", notamment:

- enquête sur le trafic routier dans trois régions métropolitaines (Vancouver, Toronto et Montréal),
- rencontre avec les organismes d'exploitation des réseaux routiers et visite du réseau de Montréal,
- examen des données fournies par les organismes d'exploitation,
- définition des systèmes de surveillance et de régulation envisageables pour Montréal,
- présentation des divers projets aux autorités gouvernementales,
- mise au point finale du projet choisi pour la région de Montréal,
- estimation des coûts,
- choix des équipements constitutifs du système,
- inventaire des techniques de gestion applicables aux réseaux de Vancouver et de Toronto,
- définition des étapes d'implantation d'un système typique de gestion d'autoroute.

18. Mots-clés	19. Diffusion
Economie d'énergie, gestion du trafic routier, grandes routes, autoroutes, congestion, accidents	Le CDT dispose d'un nombre limité d'exemplaires, qui seront fournis sur demande.

20. Classification de sécurité (de ce rapport)	21. Classification de sécurité (de cette page)	22. Nombre de pages	23. Prix
non-classifié	non-classifiée	144	aucun

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the advice by the Steering Committee and especially the assistance provided by the following during Phase II of the study:

Catherine Hirou	Transportation Development Centre, Transport Canada
Jean-Claude Larrivée Marcel Mercier Tam Phuoc Nguyen Sandra Sultana	Ministry of Transportation - Province of Quebec
Richard Vézina Réjean Denoncourt	City of Montreal
Stephen H. Reynolds Lorne Holowachuk	Ministry of Transportation & Highways - Province of British Columbia
Colin A. Rayman	Ministry of Transportation & Communications - Province of Ontario
David Richardson Leslie Kelman Richard Gordon	Metropolitan Toronto

The authors would also like to thank Joy Walker for her excellent work in typing the document.

The study was conducted under the Department of Supply and Service (DSS) Contract No. T8200-3-3550 dated 17 May 1984, issued as a result of a proposal submitted in response to DSS Request for Proposals 17/T00-SV-2-3001. Funding for this project was provided through Transport Canada's allocation of resources under the Federal Energy Research and Development Program.

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I N T R O D U C T I O N

FEDERAL GOVERNMENT PROGRAM

In recognition of the importance of energy conservation in the transportation sector, and in accordance with the specific objectives of the Conservation in Transportation Program, Transport Canada has initiated a project entitled, "Freeway Management Systems for Transportation Efficiency and Energy Conservation".

The ultimate goal of the project is to increase the efficiency of passenger and freight transportation in major Canadian urban corridors. The project is aimed at collecting information on current freeway management system concepts and documenting these in a format that will encourage the review and implementation of these systems in Canada.

This "Technical Memoranda" accompanies four reports prepared during Phase I of the "Freeway Management Systems for Transportation Efficiency and Energy Conservation" project. The four reports are:

- "Summary of North American and European Projects" - which presents a state-of-the-art summary of selected major freeway management projects already implemented or under construction in North America and Europe. (TP6640E)

- "Bibliography of Key References" - which contains a highly selected bibliography of technical literature considered to be most useful as a reference to practising traffic engineers who require more comprehensive information and wish to examine approaches used in several selected projects. (TP6639E)

- "Practical Planning Guide for Traffic Engineers" - which can be utilized as an introductory planning guide by traffic engineers and transportation planners at the working and research levels who are responsible for planning, designing and implementing freeway management systems. (TP6220E)

- "Overview" - which describes the various freeway management concepts and their main applications at a more strategic level - making it a potentially useful reference for the senior management and other decision-makers. (TP6343E)

REPORT OBJECTIVE

The objective of this report is to provide information on work accomplishments during Tasks 1-10 (originally F.1-F.9 & G) of Phase II of the project entitled "Freeway Management Systems for Transportation Efficiency and Energy Conservation".

FREEWAY TRANSPORTATION SCENE IN THREE METROPOLITAN AREAS

PURPOSE

The purpose of Task 1 was to review road maps and the most recent areawide traffic operations reports that were readily available for the metropolitan areas of Vancouver, Toronto and Montreal - in order to:

1) establish, in broad terms, the range of possible freeway management opportunities within each area;

2) brief the Steering Committee on the findings; and

3) obtain a decision on which metropolitan area is to be selected for the concept design effort in Tasks 2 through 8.

FREEWAY MANAGEMENT OPPORTUNITIES IN VANCOUVER

The review of available reports and maps for the Vancouver metropolitan area included consideration of the following factors:

a) geographic layout
b) traffic impacts
c) major traffic generators
d) travel needs
e) travel modes
f) jurisdictions
g) roadway maps
h) traffic operations report
i) provincial highways
j) northern crossings
k) southern crossings for downtown, and
l) additional southern crossings.

Brief highlights from the review are presented in point form in Appendix A/p. 2-4.

Based on the review of the geographic, jurisdictional and transportation settings, and on the review of travel demand patterns, several freeway management opportunities were identified:

a) peripheral parking lots for bus operations;
b) HOV lanes;
c) freeway incident management teams;
d) bridge surveillance systems;
e) driver information (HAR) and route diversion systems;
f) incident management systems;
g) pre-trip planning systems; and
h) special event management for Expo 86.

The possible freeway management opportunities for the Vancouver metropolitan area are summarized in Appendix A/p. 5-6 and illustrated on the attached map in Appendix A/p.7.

FREEWAY MANAGEMENT OPPORTUNITIES IN TORONTO

For the Toronto metropolitan area, a review of roadway maps and available reports was undertaken. Based on this review, and on the study team's familiarity with the Toronto area transportation scene, a wide range of possible freeway management opportunities was examined. Opportunities, which seemed to present the highest return in resource (money and energy) conservation terms, were identified. These are presented in Appendix B. The locations for the projects are also identified on the attached maps of the Toronto area.

FREEWAY MANAGEMENT OPPORTUNITIES IN MONTREAL

As a result of a review of the road maps and available reports, and on the basis of the field trips in the Montreal metropolitan area, a list of possible freeway management opportunities was prepared (Appendix C). The locations of several of these projects are indicated on the attached map in Appendix C and on individual maps in Appendices D through G. In addition, two maps of a possible freeway management project focusing on the interchange of the Metropolitan Expressway and the Decarie Expressway are indicated on pages 28 and 29.

SELECTION OF METROPOLITAN AREA BY STEERING COMMITTEE

The area reviews and the identified freeway management opportunities for the metropolitan areas of Vancouver, Toronto and Montreal were presented at the Steering Committee meeting of 5 March 1985. (The attached, updated project lists include changes made based on the comments of the committee

members). Based on the presentations, and following a detailed discussion, the Steering Committee selected the Montreal metropolitan area for the concept design effort in Tasks 2 through 8.

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MEETINGS WITH OPERATING AGENCIES AND TOUR OF EXISTING ROADWAYS - MONTREAL, QUEBEC

PURPOSE

As a result of the selection (in Task 1) of the Montreal metropolitan area for the concept design effort of Tasks 2 through 8, meetings were held with the provincial and municipal agencies responsible for the freeway and related major arterial networks within the metropolitan area. The purpose of Task 2 was to obtain input and information on implemented treatments and projects. Tours were made of existing facilities to examine existing problems and potential opportunities for freeway management systems.

MEETINGS WITH OPERATING AGENCIES

The following meetings were held with the operating agencies within the Montreal metropolitan area:

1) On March 6, 1985, a meeting was held in the offices of the Ministère des Transports, Direction des traces et projets, Division circulation et aménagements. Following is a list of participants:

   * Jean-Claude Larrivée, Chef du Service
   * Marcel Mercier, Chef de Division
   * Tam Nguyen, Section études de circulation
   * Sandra Sultana, Section études de circulation
   * Jacques Thibeault, Section études de circulation

2) On March 6, 1985, a meeting was held in the offices of the Ministère des Transports, Direction générale du transport terrestre des personnes. Following is a list of participants:

   * Gilles Lussier, Directeur de l'expertise technique et des projets
   * Nguyen Quang Quy, Directeur de projets
   * Yvon Parenteau, Directeur de projets
   * Louise Loiselle, Ing.
   * Michele St.-Jacques, Ing.

3) On March 7, 1985, a meeting was held in the offices of Ville de Montréal, Division Technique, Service de la circulation. Participants were:

   * Richard Vézina, Surintendant
   * Réjean Denoncourt, Chef d'équipe

RANGE OF TOPICS COVERED AT THE MEETINGS

At each of the three meetings noted above, discussions centered on a review of the possible freeway management systems that were developed in Task 1.

At the meeting with the Division circulation et aménagements, Direction des tracés et projets, the freeway management opportunites discussed for the metropolitan area included:

a) special incident detection/verification/response systems;
b) ramp metering/driver information systems on the freeways within the city;
c) preferential and exclusive treatment of HOVs on some freeway ramps, major arterials and the river crossings; and
d) three separate alternative route diversion systems (for the crossings of the St. Lawrence River, for the crossings between Montreal and Laval, and for Highways #40 and #20 from Dorion).

Several other innovative measures, such as pre-trip planning systems for the CBD employment concentrations, were also reviewed. However, the major item discussed was the need to develop a concept plan for a freeway corridor management system along Highway #40 from Highway #13 to Highway #25. Such a system would need to include more intensive applications of techniques between the Highway #40/Highway #520 Interchange and Boulevard St. Laurent, as well as extensions along Autoroute Des Laurentides and the Decarie Expressway, and the service roads of the Metropolitan Expressway and the Decarie Expressway. This corridor was identified as the first freeway traffic management priority in the metropolitan Montreal area primarily due to the persistent delays caused by high traffic volumes and frequent incidents. At present, the incidents are not detected, verified or cleared nearly quickly enough. Unneccessary delays, air pollution, excessive fuel consumption and aggravation to the motorists occur. In addition, traffic jams extend onto the arterial streets.

Implementation of a freeway management system in this corridor would clearly be one of the most cost-effective transportation investments that can be made at the present time in the metropolitan Montreal area. Discussions with the Province indicated that such a freeway management system

would allow the optimization of the use of existing infrastructure, thereby helping to defer the need for other, far more capital intensive major road and transit projects.

At the meeting with the staff from the Ministère des Transports, Direction générale du transport terrestre des personnes, Gilles Lussier advised of their recent efforts to establish HOV lanes on several of the bridge crossings. They advised that they had suggested various HOV projects to the City of Montreal. However, the city's priorities appeared to be concentrated on improving the traffic flow within the City of Montreal rather than on the entrance roadways to Montreal from the surrounding suburban areas. They advised that there are three project locations where HOV techniques have been applied and/or considered:

* the Champlain Bridge over the St. Lawrence River, an HOV bus lane is presently being operated
* the Mercier Bridge has also been recommended as a location for the application of an HOV lane
* the Viau Bridge has been recommended as a possible location for the implementation of an exclusive bus lane as part of the reconstruction of the bridge structure.

Mr. Lussier also advised that they had considered the application of an HOV lane at the Lafontaine Tunnel; however, there was not a sufficient number of buses to warrant further consideration.

At the meeting with the City of Montreal on March 7, 1985, Richard Vezina concurred with the need for the implementation of a freeway traffic management system on Metropolitan Expressway and Decarie Expressway. (This freeway management project received top priority from both the Province and the City.) He also provided information on the City's commitment to setting up a centralized computer control facility for its traffic signal operation. He advised that it appeared feasible to coordinate the operation of the freeway management system with the City's proposed traffic control signal system. He agreed that this cooperative effort between the two control centers would provide a much higher overall efficiency, and in the process, benefit both the freeway and the arterial systems. It was

noted that this would be the first such implementation in Canada and would well demonstrate the foresight and innovation of the local planning and political communities.

MATERIALS RECEIVED FROM THE OPERATING AGENCIES

The following materials were received from the Ministere des Transports, Division circulation et amenagements, Direction des traces et projets:

a) to scale strip maps of the Metropolitan Expressway and the Decarie Expressway and their service roads;

b) an overall map of the Autoroutes de l'ile de Montreal;

c) to scale drawings of the interchange of Highways #15 and #40;

d) traffic volume counts of the entrance ramps at the interchange of the Metropolitan Expressway and Decarie Expressway;

e) traffic volume information at various points along Highways #15 and #40 that were prepared as part of a separate intersection study;

f) traffic machine count information at permanent count stations on Highways #15 and #40;

g) intersection turning movement counts at selected intersections adjacent to Highways #15 and #40;

h) a reduced set of to-scale plans of existing signing locations and texts on the Metropolitan Expressway;

i) to-scale plan of existing signing locations and texts on the Decarie Expressway; and

j) an emergency service plan report for the Ville Marie Expressway between the Turcot interchange and the Ville Marie Tunnel.

At the meeting with the Minstere des Transports, in the afternoon of March 6, 1985, Gilles Lussier provided a copy of the report entitled "Les Options de Reseaux de Transport en Commun sur la Rive Sud de Montreal".

At the meeting with the City of Montreal Richard Vezina provided the following information:

a) a large scale map of the City of Montreal with prioritized locations indicated based upon the existing traffic congestion problems;

b) a listing of the critical traffic congestion locations entitled "Description des Endroits Critiques"; and

c) a to-scale plan of service roads of the Metropolitan Expressway and Decarie Expressway denoting locations of existing traffic signals, under the jurisdiction of the City of Montreal.

TOUR OF EXISTING ROADWAYS

On March 6, 1985, Marcel Mercier and his staff provided an escorted tour of the traffic corridors along Highways #15 and #40. This tour included the examination of the adjacent service roads, the entrance/exit ramps, the interchanges, and the alternative routes. The tour included their verbal description and observation of the existing traffic congestion problems.

On March 4, 5, 6, and 7, 1985, the consultant team toured the various roadways within the metropolitan area of Montreal. This tour included the various St. Lawrence River crossings, the crossings to Laval, the southwest crossings, and the crossings to Charlemagne. Also, the expressway facilities within the City of Montreal were toured.

CONCLUSIONS

As a result of the meetings with the operating agencies and the tour of existing roadways, the following was accomplished:

1. the existing freeway management problems were noted;
2. the possible solutions to these problems were discussed;
3. treatments that have already been applied to attempt to solve the problems were reviewed;
4. future projects that are now under consideration by the Province and the City were noted;
5. available traffic data was obtained from the operating agencies;
6. the possible freeway management system opportunities were determined; and
7. the highest priority for the application of freeway management systems was determined to be the Metropolitan Boulevard Expressway and the Decarie Expressway corridor facilities.

The obtaining of the traffic data and the establishment of the priority of the freeway management corridor system will permit the completion of Tasks 3 through 8.

REVIEW OF SUMMARY DATA PROVIDED BY THE AGENCIES

PURPOSE

The purpose of Task 3 was to review the summary data provided by the government agencies in order to assure that there are no readily observable conditions which might preclude the need for, or the possible successful operation of, any particular traffic surveillance and control technique that may be implemented on the Metropolitan Expressway and the Decarie Expressway in Montreal.

REVIEW AND USE OF MATERIALS RECEIVED

The summary data provided (p. 10) was used in the applicability study for the following purposes:

a) Familiarization with roadway configurations.
b) Determination of major facilities, and their approximate volume and capacity relationship.
c) Definition of problem locations.
d) Determination of facilities to be included in the projects.
e) Determination of project limits.
f) Determination of staging limits.

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DEVELOPMENT OF POSSIBLE CONCEPTS FOR SPECIFIC TRAFFIC SURVEILLANCE AND CONTROL SYSTEMS

PURPOSE

The purpose of Task 4 was to prepare a list of the most promising types of traffic surveillance and control systems which could be installed in Montreal as demonstration projects for energy conservation. This list was developed based upon meetings with government agencies, tours of the highway facilities, and a brief review of available traffic data which was obtained during Task 3 from the government agencies.

APPROACH

Based upon the apparent severity of existing identified problems, and the potential for obtaining improved traffic flow conditions and increasing the person throughput capability of a specific facility or its corridor, a preliminary list of several systems was prepared. The list was developed to permit:

1) early implementation of an individual system;
2) staging of a project; and
3) expansion of the project into an overall system.

For instance, several selected projects may be combined into an overall "Montreal Freeway Management System", that would include all major freeway facilities and the tunnel and bridge crossings.

Please note that the Ville Marie Expressway, which was identified as a separate project, has been added to the Decarie/Metropolitan Freeway Corridor Traffic Management System as a result of the request by the Province of Quebec at the meeting of June 5, 1985.

Comments from the Province, that were contained in a letter dated June 13, 1985, were incorporated into this Technical Memorandum for Task 4.

The document, prepared by the consultant team during Phase I (Task D), entitled "Practical Planning Guide for Traffic Engineers" was utilized extensively in Task 4 to:

1) define the objectives of each project;
2) select techniques for implementation; and
3) identify specific equipment.

MOST PROMISING PROJECTS IN MONTREAL

The types of freeway management systems considered for implementation in Montreal are broken down into five categories:

* Individual Bridge Surveillance Systems
* Driver Information and Diversion Systems
* High Occupancy Vehicle (HOV) Systems
* Freeway Surveillance and Control Systems
* Corridor Management Systems

Projects considered most promising within each of these categories are listed in the following. More detailed information on each category is presented in Tables 1-8.

Individual Bridge Surveillance Systems

The various individual bridges that lead to and from the island of Montreal were identified as locations where freeway management opportunities can be considered.

1) Saint Lawrence River South and East Crossings from Caughnawaga, Brossard, Longueuil, Boucherville
   a) Pont Honoré Mercier (#138)
   b) Pont Champlain (#20, #10, #15)
   c) Pont Victoria
   d) Pont Jacques Cartier (#116)
   e) Louis-Hippolyte/LaFontaine Tunnel (#25)

2) South/West Crossings from Vaudreauil and Dorion
   a) Pont de l'Île aux Tourtes (#40)
   b) Pont Taschereau and Pont Galipeault (#20)

3) Crossings from Laval
   a) Pont Louis Bisson (#13, Autoroute Chomeday)
   b) Pont Lachapelle (#117, Boulevard Laurentien)
   c) Pont Médéric-Martin (#15, Autoroute des Laurentides)
   d) Pont Viau (#335, Boul. des Laurentides/Saint-Denis)
   e) Pont Papineau Leblanc (#19, Avenue Papineau)
   f) Pont Pie IX (#125, Boulevard Pie IX)

4) North Crossing from Charlemagne and Repentigny
   a) Highway #40 (Autoroute de la Rive-Nord)
   b) Pont Le Gardeur (#138, Sherbrooke)

The proposed individual bridge surveillance systems, and the main techniques, equipment and other considerations are presented in Table 1. Locations are displayed in Appendix D.

Driver Information & Diversion Systems

The facilities at each of the most promising locations - where freeway management opportunities exist to provide information on traffic conditions on a primary route and on its alternative routes, so that the motorist can select the best route - are listed in the following:

1) St. Lawrence River Driver Information, Alternative Routing & Diversion System.
   a) Highways #15 and #20 and #134
   b) Pont Champlain
   c) Pont Victoria
   d) Pont Jacques Cartier
   e) Louis-Hippolyte/LaFontaine Tunnel

2) Dorion Diversion and Driver Information System
   a) Highway #20, Highway #540, Highway #40
   b) Pont de Île Aux Tourtes (Highway #40)
   c) Highway #20 from Île Perrot

3) Laval Driver Information, Alternative Routing and Diversion System
   a) Highways #440 and #148
   b) Pont Louis Bisson
   c) Pont Lachapelle
   d) Pont Médéric-Martin
   e) Pont Viau
   f) Pont Papineau LeBlanc
   g) Pont Pie IX

4) Charlemagne Driver Information, Alternative Routing and Single Point Diversion System
   a) Highways #640 and #344
   b) Highway #40 Crossing
   c) Pont Le Gardeur

The proposed driver information and diversion systems, their main techniques, equipment and other considerations are presented in Tables 2-5. Locations for each of these projects are displayed in Appendix E.

HOV Systems

The most promising location for consideration of implementing a preferential lane treatment for high occupancy vehicles is:

1) Pont Honoré Mercier
   a) Highways #138 and #132
   b) Pont Honoré Mercier

Further details on the Pont Honoré Mercier HOV system are presented in Table 6. A location map for this project is provided in Appendix F.

Freeway Surveillance and Control Systems

Two promising locations for consideration of implementing freeway management systems on linear expressway facilities are:

1) Ville Marie Expressway Surveillance and Control System
   a) Ville Marie Expressway
   b) Ville Marie Tunnel (a successful system is already in operation)
   c) Highway #138 and selected major arterials as a possible back-up

2) Highway #15 and #20 Freeway Surveillance and Control System
   a) Highway #15
   b) Highway #20

Further details for the proposed freeway surveillance and control systems are presented in Tables 7 and 8. Locations are displayed in Appendix G.

Corridor Management Systems

The most promising location for consideration of implementing a freeway management system that includes at least two expressways, parallel service roads and intersecting streets or expressways includes the following facilites:

1) Decarie/Metropolitan Freeway Corridor Management System
   a) Highway #40
   b) Highway #15
   c) Highway #520
   d) Highways #13, #117, #335, #19, #25 and #138, #20
   e) Service Roads of Highway #40
   f) Service Roads of Highway #15

Further details for the proposed corridor management system are presented in Table 9. Location maps for this high priority project follow Table 9 in the main body of the report.

TABLE 1

INDIVIDUAL BRIDGE SURVEILLANCE SYSTEMS

OBJECTIVES

To manage the traffic at various bridge facilities in order to:

a) Provide instantaneous incident detection, verification and a quick response capability - thereby lessening delays imposed on the motorists;

b) overcome difficulties encountered by emergency response vehicles in reaching the site of an incident;

c) mitigate the inherent bottleneck characteristics of a facility with the reduced number of lanes on the bridge, which often creates long lines of vehicles behind an incident.

FACILITIES

Bridges that are candidates for the installation of a bridge surveillance system include:

1) Saint Lawrence River South & East Crossings from Caughnawaga, Brossard, Longueuil, Boucherville
   a) Pont Honore Mercier (#138)
   b) Pont Champlain (#20, #10, #15)
   c) Pont Victoria
   d) Pont Jacques Cartier (#116)
   e) Louis-Hippolyte/LaFontaine Tunnel (#25)
2) South/West Crossings from Vaudreauil and Dorion
   a) Pont de Ile aux Tourtes (#40)
   b) Pont Taschereau and Pont Galipeault (#20)
3) Crossings from Laval
   a) Pont Louis Bisson (#13, Autoroute Chomeday)
   b) Pont Lachapelle (#117, Boulevard Laurentien)
   c) Pont Mederic-Martin (#15, Autoroute des Laurentides)
   d) Pont Viau (#335, Boul. des Laurentides/Saint-Denis)
   e) Pont Papineau Leblanc (#19, Avenue Papineau)
   f) Pont Pie IX (#125, Boulevard Pie IX)
4) North Crossing from Charlemagne and Repentigny
   a) Highway #40 (Autoroute de la Rive-Nord)
   b) Pont Le Gardeur (#138, Sherbrooke)

TECHNIQUES

- Incident Detection
- Incident Verification
- Incident Response
- Bridge Surveillance and Control
- Possible Reversible Bus Lanes
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Emergency Phone
- Emergency Call Box
- CCTV
- Closely Spaced Loop Detection
- Increased Police Patrols
- Emergency Response
- Franchised Tow Truck Operation
- Traffic Control Signals & Variable Message Signs
- 24 Hour Staffing & Operation
- Possible HOV Reversible Lane
- Possible Reversible Lane for Automobile Traffic
- Various Communications Medium
- Establishment of Central Computer Control Room & Monitoring System

OTHER CONSIDERATIONS

- Possible expansion to an alternative routing and single point diversion system.
- Increased staffing during A.M. and P.M. peak hours.
- Coordination with adjacent government agencies.
- Coordination with City traffic signal system.

TABLE 2

SAINT LAWRENCE RIVER DRIVER INFORMATION, ALTERNATIVE ROUTING & DIVERSION SYSTEM

OBJECTIVES

To provide the motorist with information on roadway conditions in order to permit the motorist to divert from one roadway to an alternative roadway in order to reach a common end point.

FACILITIES

a) Highways #15 and #20 and #134
b) Pont Champlain
c) Pont Victoria
d) Pont Jacques Cartier
e) Louis-Hippolyte/LaFontaine Tunnel

TECHNIQUES

- Single Point Diversion
- Driver Information Signing
- Incident Detection
- Incident Verification
- Incident Response
- Bridge Surveillance and Control
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Tow Trucks
- Courtesy Patrol
- CCTV on Bridge
- Traffic Control Signals & Variable Message Signs on the Bridge
- 24 Hour Operation and Staffing
- Variable Message Signs in Advance of the Diversion Points
- Highway Advisory Radio
- Selection of Various Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Tying in of individual bridge surveillance and control systems into a single point diversion system.
- Coordination with City of Montreal computerized traffic signal system.

TABLE 3
DORION DIVERSION AND DRIVER INFORMATION SYSTEM

OBJECTIVES

To provide the motorist with information on roadway conditions in order to permit the motorist to divert from one roadway to an alternative roadway in order to reach a common end point.

FACILITIES

a) Highway #20, Highway #540, Highway #40
b) Pont de Île Aux Tourtes (Highway #40)
c) Highway #20 from Île Perrot

TECHNIQUES

- Single Point Diversion
- Driver Information Signing
- Incident Detection
- Incident Verification
- Incident Response
- Bridge Surveillance and Control
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Tow Trucks
- Courtesy Patrol
- CCTV on Bridge
- Traffic Control Signals & Variable Message Signs on the Bridge
- 24 Hour Operation and Staffing
- Variable Message Signs in Advance of the Diversion Points
- Highway Advisory Radio
- Selection of Various Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Tying in of individual bridge surveillance and control systems into a single point diversion system.
- Coordination with City of Montreal computerized traffic signal system.

TABLE 4
LAVAL DRIVER INFORMATION, ALTERNATIVE ROUTING AND DIVERSION SYSTEM

OBJECTIVES

To provide the motorist with information on roadway conditions in order to permit the motorist to divert from one roadway to an alternative roadway in order to reach a common end point.

FACILITIES

a) Highways #440 and #148
b) Pont Louis Bisson
c) Pont Lapachelle
d) Pont Médéric-Martin
e) Pont Viau
f) Pont Papineau LeBlanc
g) Pont Pie IX

TECHNIQUES

- Diversion and Alternate Routing
- Driver Information Signing
- Incident Detection
- Incident Verification
- Incident Response
- Bridge Surveillance and Control
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Tow Trucks
- Courtesy Patrol
- CCTV on Bridge
- Traffic Control Signals & Variable Message Signs on the Bridge
- 24 Hour Operation and Staffing
- Variable Message Signs in Advance of the Diversion Points
- Highway Advisory Radio
- Selection of Various Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Tying in of individual bridge surveillance and control systems into an alternative routing and diversion system.
- Coordination with City of Montreal computerized traffic signal system.
- Tying in with present and future HOV operations.

TABLE 5

CHARLEMAGNE DRIVER INFORMATION, ALTERNATIVE ROUTING AND SINGLE POINT DIVERSION SYSTEM

OBJECTIVES

To provide the motorist with information on roadway conditions in order to permit the motorist to divert from one roadway to an alternative roadway in order to reach a common end point.

FACILITIES

a) Highways #640 and #344
b) Highway #40 Crossing
c) Pont Le Gardeur

TECHNIQUES

- Single Point Diversion
- Driver Information Signing
- Incident Detection
- Incident Verification
- Incident Response
- Bridge Surveillance and Control
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Tow Trucks
- Courtesy Patrol
- CCTV on Bridge
- Traffic Control Signals & Variable Message Signs on the Bridge
- 24 Hour Operation and Staffing
- Variable Message Signs in Advance of the Diversion Points
- Highway Advisory Radio
- Selection of Various Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Tying in of individual bridge surveillance and control systems into a single point diversion system.
- Coordination with City of Montreal computerized traffic signal system.

TABLE 6

PONT HONORÉ MERCIER HOV PREFERENTIAL LANE OPERATION

OBJECTIVES To optimize the person throughput capability of the bridge facility by providing preferential or exclusive treatment to vehicles containing several occupants.
FACILITIES a) Highways #138 and #132 b) Pont Honoré Mercier
TECHNIQUES - Use of Existing Bridge Lane for HOVs - Preferential Ramps
SPECIFIC EQUIPMENT - Pavement Markings - Advisory Signs - Variable Message Signs - Overhead Lane Control Signs - Highway Advisory Radio - Additional Police Patrols and Enforcement
OTHER CONSIDERATIONS - Tying in with outlying peripheral parking lots. - Tying in with preferential parking in downtown locations. - Tying in with possible designation of exclusive HOV ramps. - Tying in with priority entry by-pass lanes at the entrance to the bridge.

TABLE 7

VILLE MARIE EXPRESSWAY SURVEILLANCE AND CONTROL SYSTEM

OBJECTIVES

To efficiently manage the existing expressway facility in order to provide surveillance and control features necessary to reduce delays to motorists.

FACILITIES

a) Ville Marie Expressway
b) Ville Marie Tunnel (a successful system is already in operation)
c) Highway #138 and selected major arterials as a possible back-up

TECHNIQUES

- Driver Information Signing
- Incident Detection
- Incident Verification
- Incident Response
- Tunnel Surveillance and Control
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Tow Trucks
- Courtesy Patrol
- CCTV outside Tunnel
- Traffic Control Signals & Variable Message Signs
- 24 Hour Operation and Staffing
- Highway Advisory Radio
- Selection of Various Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Coordination with City of Montreal computerized traffic signal system.
- Tying in with existing Ville Marie Tunnel surveillance and control operation.

TABLE 8

HIGHWAYS #15 and #20 FREEWAY SURVEILLANCE AND CONTROL SYSTEM

OBJECTIVES

To provide the motorist with information on roadway conditions to permit the motorist to divert to various St. Lawrence River crossings.

FACILITIES

a) Highway #15
b) Highway #20

TECHNIQUES

- Alternate Routing
- Incident Detection
- Incident Verification
- Incident Response
- Ramp Metering
- Driver Information Signing
- Highway Advisory Radio
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Emergency Call Boxes
- Remote CB Radio Monitoring
- Courtesy Patrols
- Tow Trucks
- Heavy Duty Equipment
- Variable Message Signs
- Traffic Responsive Ramp Metering
- Highway Advisory Radio
- Selection of Communications Medium
- Central Computer Control Room

OTHER CONSIDERATIONS

- Tying in with individual bridge surveillance and control systems.
- Coordination with City of Montreal computerized traffic signal system.
- Coordination with possible HOV operations.

TABLE 9

DECARIE/METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM

OBJECTIVES

To efficiently manage the traffic flow on a roadway network that includes two freeways, freeway ramps, the adjacent service roads of the two freeways, and intersecting highways in order to communicate with the motorist and reduce congestion and delays to the motorist.

FACILITIES

a) Highway #40
b) Highway #15
c) Highway $520
d) Highways #13, #117, #335, #19, #25 and #138, #20
e) Service Roads of Highway #40
f) Service Roads of Highway #15

TECHNIQUES

- Incident Detection
- Incident Verification
- Incident Response
- Ramp Metering
- Driver Information Signing
- Highway Advisory Radio
- Pre-trip Planning
- Arterial Signals
- Communications
- Central Computer Control

SPECIFIC EQUIPMENT

- Electronic Surveillance
- Emergency Call Boxes
- Remote CB Radio Monitoring
- CCTV at the Decarie Interchange
- Courtesy Patrols
- Franchised Tow Truck Operation
- Heavy Duty Tow Truck Equipment
- Traffic Responsive and System Responsive Ramp Metering
- Variable Message Signs
- Highway Advisory Radio
- Telephone Call-in Number
- Computerized Arterial Signal Systems on the Service Roads
- Selection of Communications Medium
- Full Implementation of Central Computer Control Room (Computers, Computer Peripherals, Control Console, Central Communications Unit, Map Display, System Monitors)
- Overhead Lane Control Signals

OTHER CONSIDERATIONS

- Tying in with the City of Montreal computerized traffic signal system.
- Extending surveillance and control further back along intersecting highways.
- Reduction of needs to widen expressway facility via the implementation of traffic surveillance and control techniques
- Special signing through interchange area.
- Upgrading of pavement markings along highways and interchange areas.

FIGURE 1

DECARIE/METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM

-METROPOLITAN EXPRESSWAY SECTION-

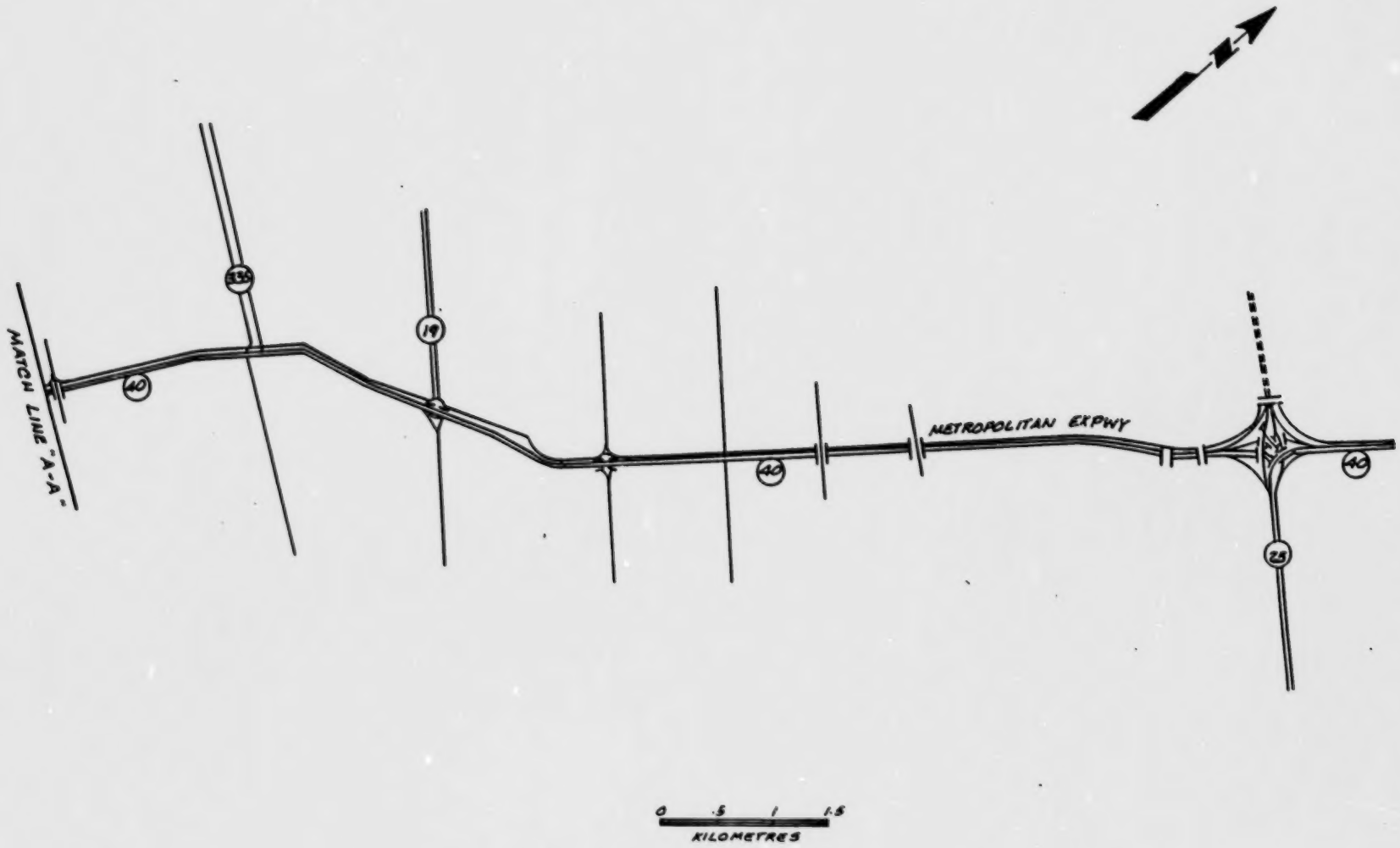
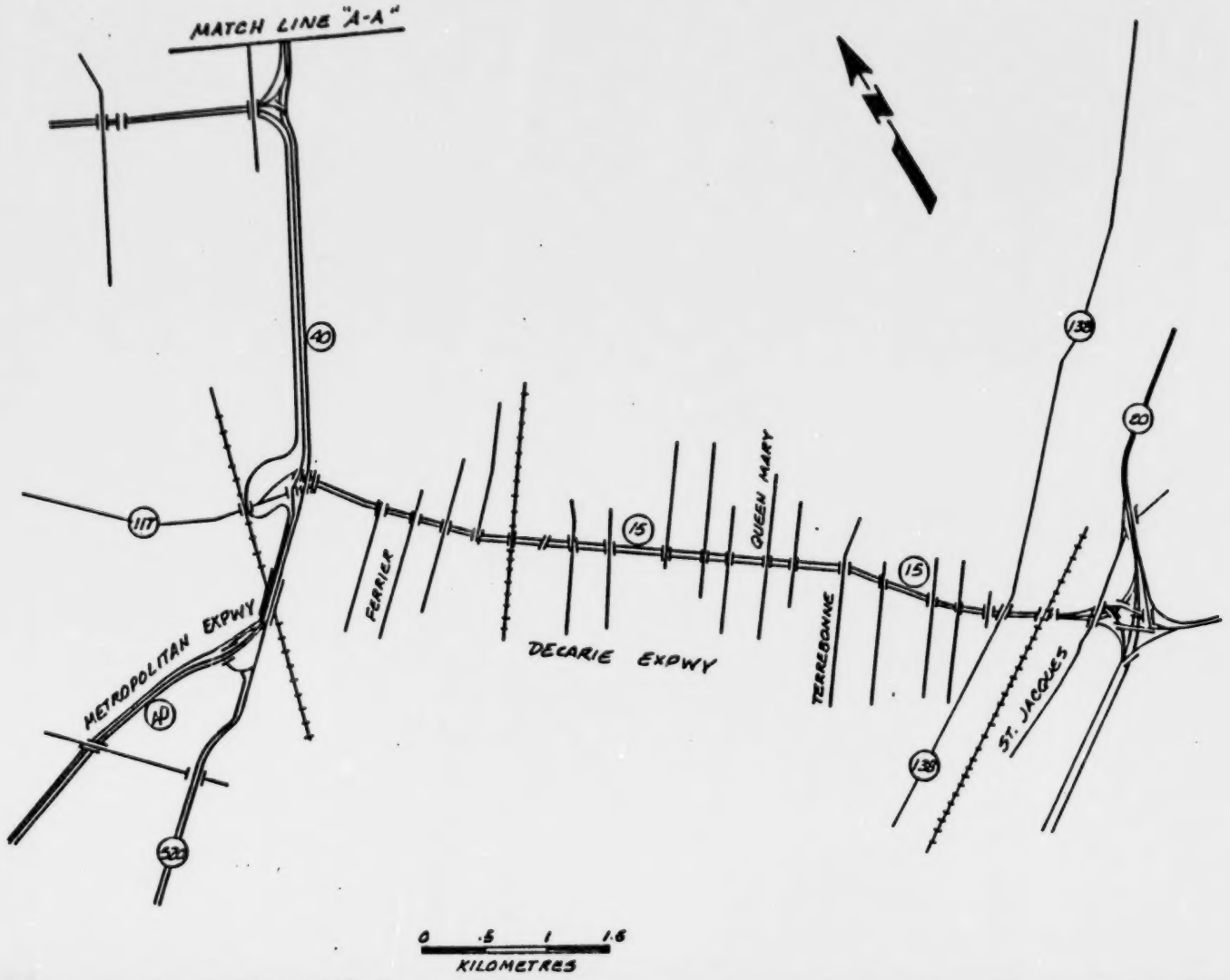


FIGURE 2

DECARIE/METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM

-DECARIE EXPRESSWAY SECTION-



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REVIEW OF POSSIBLE PROJECTS WITH GOVERNMENT AGENCIES

PURPOSE

The purpose of Task 5 was to review the list of the most promising freeway management projects (Task 4) with the government agencies to obtain their input and participation in selecting one project for further examination.

APPROACH

After an initial review of the three metropolitan areas at the March 5, 1985 Steering Committee meeting, the Decarie Expressway and the Metropolitan Expressway were chosen as the primary freeway management project for Montreal.

A meeting was held on the morning of June 5, 1985 with the Province of Quebec, City of Montreal and Transport Canada. The purpose of this meeting was to review the scope of the proposed project on the Decarie Expressway and the Metropolitan Expressway.

A draft of Task 4 was reviewed at the Steering Committee meeting held on June 6, 1985. Elements and needs of each possible project were reviewed so that the operating agencies recognized the purpose and extent of these projects, as well as their required involvement. Possible projects were presented for expansion, leading to the selection of one project, the Decarie/ Metropolitan Expressway, for more detailed examination.

FINDINGS

As a result of the discussions held at the meetings of June 5th and June 6th, the following was determined:

1) The corridor management system for the Decarie Expressway and the Metropolitan Expressway should be staged to optimize the use of available funds.

2) The final staging of the project should include the incorporation of an overall Freeway Management System that includes the Ville Marie Expressway.

3) Cost savings can be realized due to the existence of an available conduit along sections of the Metropolitan Expressway.

4) The preliminary cost estimates should be revised on the basis of (a) available and future funds, (b) the staging of the project, (c) the proposed geometric modifications at the Decarie Interchange, and (d) conduit cost savings.

PREPARATION OF FINAL MODIFICATIONS TO THE SELECTED PROJECT

PURPOSE

The purpose of Task 6 was to modify, based upon the review of possible projects with the government agencies, the limits and the elements of the selected freeway management project so that it would best meet the needs of the operating agencies.

RECOMMENDED FINAL MODIFICATIONS

The final modifications were identified on the basis of inputs received at the morning meeting of June 5, 1985 with the Province, the City of Montreal and Transport Canada - and through the participation of the provincial staff at the working session on the afternoon of June 5, 1985. The modifications included the following:

a) number of elements
b) roadway lengths and project limits
c) project staging

Attendees at the morning and afternoon meetings of June 5, 1985 from the government agencies were:

* Transport Canada
  - Catherine Hirou, Project Officer
* Province of Quebec
  - Jean Claude Larrivée, Chef du Service
  - Tam Nguyen, Section études de circulation
  - Sandra Sultana, Section études de circulation
  - André Roy, Division Circulation et aménagements
* City of Montreal
  - Richard Vézina, Surintendant
  - Réjean Denoncourt, Chef d'équipe

The Province requested that the Ville Marie Expressway Traffic Surveillance and Control System be included as part of the Corridor Management Project on the Decarie and Metropolitan Expressways. With the incorporation of the Ville Marie Expressway in the overall system, the need was recognized by the Province to consider the installation of incident detectors for automatic detection at several locations on the Ville Marie Expressway.

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DEVELOPMENT OF COST ESTIMATES

PURPOSE

The purpose of Task 7 was to develop approximate, order-of-magnitude cost estimates for the selected freeway corridor management system - including the Metropolitan and Decarie Expressways. Cost information provided in the document entitled "Practical Planning Guide for Traffic Engineers" was used to compile these estimates.

INITIAL COST ESTIMATE

An initial cost estimate was presented at the morning meeting of June 5, 1985 with the Province, the City of Montreal and Transport Canada (Table 10). The various elements of the selected system were defined. Tentative locations of each of the field components were identified to determine the number of each element. Then the appropriate costs for each element, that were presented in the "Practical Planning Guide for Traffic Engineers", were used to estimate the total cost for each element.

REVISED COST ESTIMATE

The initial cost estimate was refined, based on the input provided by the Province and the City at the meeting of June 5, 1985 (Table 11).

The following cost saving factors, which resulted in modifying the original cost estimate, were recognized:

a) The existence of a previously installed conduit along portions of the Metropolitan Expressway eliminates the need to provide a conduit along the entire expressway as included in the original cost estimate.

b) Several variable message signs on and near the Ville Marie Expressway, which were included in the original cost estimate, were eliminated since they were included in the proposed Ville Marie Expressway project plans. These deletions resulted from the review of plans and reports prepared by the consulting engineers (Lavalin) for the Province.

c) The Province's planned incorporation of the conduit into the reconstruction projects for physical improvements on the Decarie Expressway would be more cost-effective than subsequent installation (during the construction of the freeway management system).

d) A review of the Province's planned geometric improvements, costing $800 000.00, revealed that the Province has approximately $700 000.00 available from the budgeted $1.5 Million that may be allocated to the freeway management system.

e) A review of additional physical construction on the Decarie Expressway and the ramp leading into the Metropolitan Expressway revealed that ramp relocations and closings may result in minor cost savings attributable to reductions in the number of system elements at these locations.

SUMMARY OF PRELIMINARY COST ESTIMATE

The preliminary costs for the project were estimated on the basis of a two-stage implementation program. The first stage would include the implemention of the components within the vicinity of the interchange of the Decarie and Metropolitan Expressways. During the second stage, the project limits would be expanded northeasterly along the Metropolitan Expressway, and sections of the Ville Marie Expressway would be added.

Summary of Initial Cost Estimate (Table 12), is composed of the costs of the initial estimate. This estimate was modified to reflect the inputs from the involved agencies. These refined cost estimates are presented in Summary of Revised Cost Estimate (Table 13). Cost estimates are provided for the project phases of (1) Feasibility Study, (2) Design, (3) Construction, (4) System Integration, and (4) System Demonstration.

TABLE 10

INITIAL COST ESTIMATE

ITEM	NUMBER OF ITEMS		COST ESTIMATE	
	STAGE I	TOTAL STAGES I & II	STAGE I ($)	TOTAL STAGES I & II ($)
Inductance Loop Detectors				
- Mainline Stations	70	130	106 000	197 000
- Service Road Stations	25	50	32 000	64 000
Ramp Metering				
- Ramps	8	16	128 000	256 000
Highway Advisory Radio				
- Monopole Antenna Locations	15	---	215 000	215 000
Variable Message Signs				
- Large Disk Matrix	6	10	960 000	1 600 000
- Small Disk Matrix	15	30	300 000	600 000
- Lane Control Signs	8	15	240 000	450 000
CB Radio Monitoring				
- Remote Sites	10	10	1 500	1 500
Emergency Call Boxes				
- Locations	53	106	106 000	212 000
CCTV Verification				
- Cameras	10	10	210 000	210 000
Fixed Signs	--	---	100 000	100 000
Pavement Markings	--	---	300 000	500 000
Field Cabinets				
- Mainline Locations	35	70	105 000	210 000
- Service Road Locations	30	50	45 000	75 000
Communications				
- Mainline Coax	21 kmx2	42 kmx2	210 000	420 000
- Mainline Conduit	21 kmx2	42 kmx2	2 000 000	3 780 000
- RCU	135	270	270 000	540 000
- Line Amplifiers	53	106	106 000	212 000
- Pull Boxes	700	1260	350 000	630 000

TABLE 10

INITIAL COST ESTIMATE

(continued)

ITEM	NUMBER OF ITEMS		COST ESTIMATE	
	STAGE I	TOTAL STAGES I & II	STAGE I ($)	TOTAL STAGES I & II ($)
Traffic Signal Systems on Service Roads				
- Signal Modifications & Interconnect			150 000	150 000
- Communications & Controls			130 000	130 000
- Interface with City Control Centre			40 000	40 000
Control Centre				
- Equipment & Preparation of Available Room			700 000	700 000
TOTAL PRELIMINARY CONSTRUCTION COST ESTIMATE =			$6 804 500	$11 292 500

TABLE 11

REVISED COST ESTIMATE

ITEM	NUMBER OF ITEMS		COST ESTIMATE	
	STAGE I	TOTAL STAGES I & II	STAGE I ($)	TOTAL STAGES I & II ($)
Inductance Loop Detectors				
- Mainline Stations	70	130	106 000	197 000
- Service Road Stations	25	50	32 000	64 000
Ramp Metering				
- Ramps	13	22	208 000	352 000
Highway Advisory Radio				
- Monopole Antenna Locations	15	15	300 000	300 000
Variable Message Signs				
- Large Disk Matrix	5	9	800 000	1 440 000
- Small Disk Matrix	15	30	300 000	600 000
- Lane Control Signs	8	15	240 000	450 000
CB Radio Monitoring				
- Remote Sites	10	10	4 000	4 000
Emergency Call Boxes				
- Locations	53	106	106 000	212 000
CCTV Verification				
- Cameras	10	10	210 000	210 000
Fixed Signs	--	---	100 000	100 000
Pavement Markings	--	---	300 000	300 000
Field Cabinets				
- Mainline Locations	35	70	105 000	210 000
- Service Road Locations	30	50	45 000	75 000
Communications				
- Mainline Coax	2x21 km	2x42 km	210 000	420 000
- Mainline Conduit	2x10.5 km	2x22 km	945 000	1 980 000
- RCU	135	270	270 000	540 000
- Line Amplifiers	53	106	106 000	212 000
- Pull Boxes	400	800	200 000	400 000

TABLE 11

REVISED COST ESTIMATE

(continued)

ITEM	NUMBER OF ITEMS		COST ESTIMATE	
	STAGE I	TOTAL STAGES I & II	STAGE I ($)	TOTAL STAGES I & II ($)
Traffic Signal Systems on Service Roads				
- Signal Modifications & Interconnect			150 000	150 000
- Communications & Controls			130 000	130 000
- Interface with City Control Centre			40 000	40 000
Control Centre				
- Equipment & Preparation of Available Room			700 000	700 000
* SUB-TOTAL =			$5 607 000	$ 9 086 000
* AUTOROUTE VILLE-MARIE =				3 000 000
TOTAL MODIFIED CONSTRUCTION COST ESTIMATE =			$5 607 000	$12 086 000

TABLE 12

SUMMARY OF INITIAL COST ESTIMATE

PHASE	TOTAL IMPLEMENTATION COST	
	STAGE I ($)	STAGES I & II ($)
Feasibility Study	160 000	160 000
Design	630 000	900 000
Construction	6 800 000	11 300 000
System Integration	650 000	1 130 000
System Demonstration	350 000	450 000
TOTAL =	$ 8 590 000	$ 13 940 000

TABLE 13

SUMMARY OF REVISED COST ESTIMATE

PHASE	TOTAL IMPLEMENTATION COST	
	STAGE I ($)	STAGES I & II ($)
Feasibility Study	160 000	160 000
Design	620 000	750 000
Construction	5 607 000	12 086 000
System Integration	560 000	1 209 000
System Demonstration	350 000	485 000
TOTAL =	$ 7 297 000	$ 14 690 000

DEVELOPMENT OF FINAL DEFINITIONS FOR SYSTEM COMPONENTS

PURPOSE

The purpose of Task 8 was to define the final system components for the selected freeway management system, the Decarie/Metropolitan Freeway Corridor Management System. The limits and locations were based upon the input provided by the government agencies, which recognized the anticipated limitations and regional constraints (e.g., available funding). The extent of the definition was limited to possible locations for various types of equipment, such as variable message signs, highway advisory radio, ramp metering, etc.

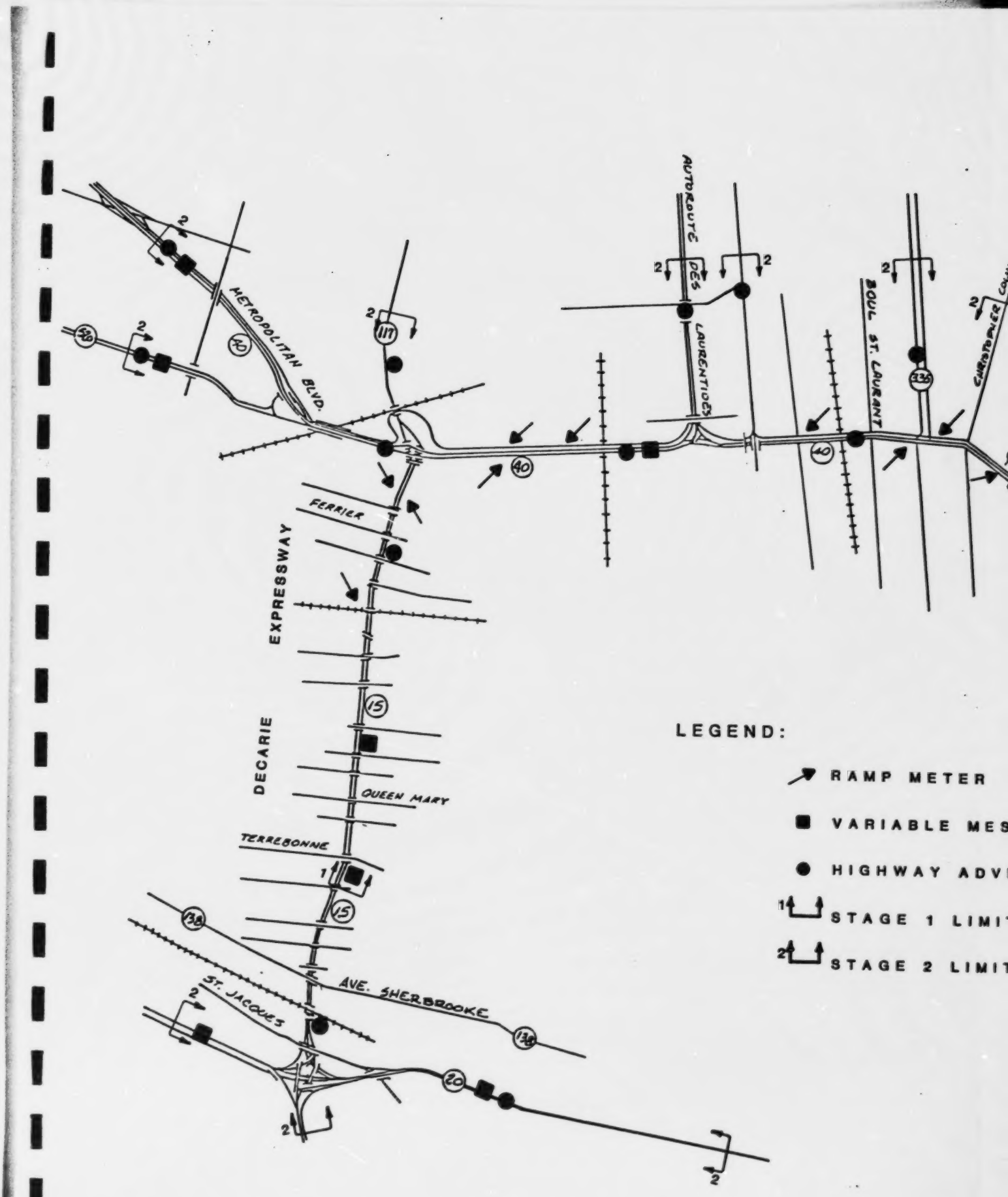
APPROACH

The approach was based on providing a brief but sufficiently in-depth examination of existing conditions through the participation of experienced personnel from the operating agencies. In this manner, the personnel from the Province and the City were able to guide and assist the consultant team in the understanding, in the shortest feasible time period, of the existing traffic flow conditions in the freeway corridors. Using this approach, the continued input and review by the operating agencies was maintained throughout the development of the possible management concepts and the selected conceptual plan. Thus, a plan was developed for the selected freeway management system that meets the needs of the operating agencies.

As discussed in the Technical Memorandum for Task 7, revised cost estimates for each component of the freeway management system were developed. The attached Figure 3 illustrates the locations of these components, as well as the staging limits for stages one and two.

By request of the Province of Quebec, the Ville Marie Expressway was added to the freeway mammagement system project. To ensure compatibility of the equipment locations specified by the Ville Marie Expressway project with the locations already determined for the Metropolitan Expressway and De-

carie Expressway, additional coordination will be necessary; however, preliminary modifications were incorporated in the final definition of system components as shown on Figure 3.


METROPOLITAN BLVD.
AUTOROUTE DES LAURENTIDES
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FERRIER
EXPRESSWAY
DECARIE
QUEEN MARY
TERREBONNE
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RAMP METER
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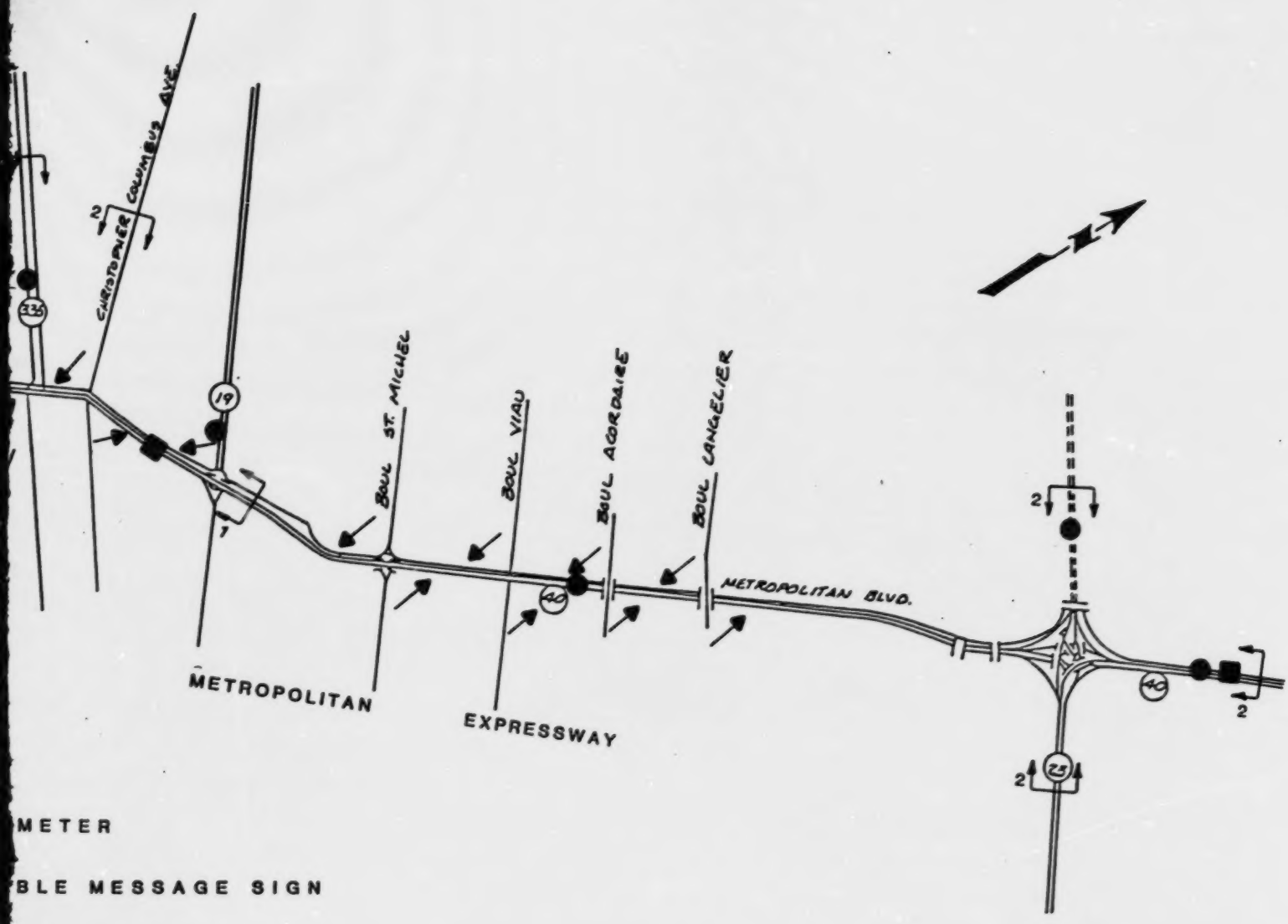

METER

BLE MESSAGE SIGN

AY ADVISORY RADIO

1 LIMITS

2 LIMITS

0 .5 1 1.5
KILOMETRES

FIGURE 3

DECARIE/METROPOLITAN
FREEWAY CORRIDOR
MANAGEMENT SYSTEM.

EQUIPMENT LOCATIONS
AND STAGING LIMITS

RANGE OF APPLICABLE FREEWAY MANAGEMENT TECHNIQUES VANCOUVER, BRITISH COLUMBIA, AND TORONTO, ONTARIO

PURPOSE

The purpose of Task 9 was to review, with the provincial staff in Vancouver and with the provincial and metropolitan staffs in Toronto, the range of applicable freeway management techniques that were previously identified in Task 1. After obtaining the input of the staffs, a list of the most feasible freeway management systems for each location was established.

APPROACH

Meetings were held in Vancouver on Monday, July 8, 1985 and Tuesday, July 9, 1985; and in Toronto on August 14 and 15, 1985 and September 8, 1985.

Discussions were held with representatives of the provincial and municipal agencies responsible for freeways in these two metropolitan areas that were not selected for the concept plan development. Their views and ideas, relating to the applicability and need for freeway management techniques to address their particular operating and travel demand circumstances, were recorded.

The situation review with the agencies also covered some of the main constraints that may restrict the implementation of a system. These reviews also identified particular techniques that would receive priority if demonstration projects were to be considered by the local agencies.

Information on the meetings with the operating agencies and the tours of the existing roadways are contained in the following two sections of this Technical Memoranda. Section 1 covers the meetings and tours held in Vancouver, British Columbia, while Section 2 covers the meetings and tours held in Toronto, Ontario.

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RANGE OF APPLICABLE FREEWAY MANAGEMENT TECHNIQUES VANCOUVER, BRITISH COLUMBIA, AND TORONTO, ONTARIO

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Section 1
Vancouver, British Columbia

MEETINGS WITH OPERATING AGENCIES

The following meetings were held with the operating agencies within the Vancouver metropolitan area:

1) On Monday, July 8, 1985, a meeting was held in the offices of the Ministry of Transportation & Highways in Victoria. A list of the meeting participants and their titles, as well as the agenda for the meeting on freeway management systems on Monday, July 8, 1985 in Victoria and on Tuesday, July 9, 1985 in Vancouver are provided in Appendix H. In addition to the participants listed in Appendix H, the Monday meetings were also attended by Maria Szedalay, Murray Tekano and Lloyd Paulson.

2) During the morning of July 9, 1985, a tour was made of the construction site of the Annacis Freeway. Bruce McKeown, Special Projects Engineer, described the various features of this massive construction effort during the tour. Mr. McKeown was assisted by Bill Henry, Dennis Dodsworth and Peter Dasnieres.

3) During the afternoon of July 9, 1985, a meeting was held in the offices of the Ministry of Transportation & Highways in Vancouver with Ron G. Rice, Chief of Transportation Systems for the 1986 World Exposition (EXPO 86).

4) In the afternoon of Tuesday, July 9, 1985, a helicopter tour was made of Highway #1, the Burnaby Freeway, during the P.M. peak traffic conditions. Following the tour, an informal meeting was held with the members of the Province to review the specific freeway management techniques that could be utilized on the Annacis Freeway and the Burnaby Freeway.

RANGE OF TOPICS COVERED AT THE MEETINGS

At the meetings held on Monday, July 8, 1985, a review was made of the work plan of the project entitled "Freeway Management Systems for Transportation Efficiency and Energy Conservation". The work accomplished to date was briefly described. The presentation of the freeway transportation scene in the Vancouver metropolitan area that was contained in Task 1 was examined in depth.

The following specific items were discussed at the July 8, 1985 meetings:

1) The freeways in the vicinity of Vancouver are under the jurisdiction of the Provincial Ministry of Transportation & Highways of British Columbia.

2) The data that had been earlier provided to the consultant team for their examination of possible projects only included information from

the Greater Vancouver Regional District planning study. No specific information had been provided by the Province.

3) The Province advised that Highway #499 has been redesignated as Highway #99.

4) There are no freeways within downtown Vancouver. All of the streets in downtown Vancouver are under the jurisdiction of the City of Vancouver.

5) The Province of British Columbia has the following freeway management systems in operation:

   a) First Narrows Bridge - A reversible lane system is operated 15 hours per day, 7 days per week. Tow truck operations are provided by contract.

   b) Second Narrows Bridge - The system includes highway patrol coverage and contract tow truck operations on the bridge.

   c) Oak Street Bridge - An incident management system is in operation with a contract tow truck that operates for 13 hours per day and also patrols the Ninth Street Bridge.

   d) George Massey Tunnel (Deas Island Tunnel) - Reversible lane operation occurs in the morning hours. An extra lane is provided for the northbound direction by utilizing one of the southbound tubes. From 6:00-8:00 A.M., three lanes are operated northbound and one lane southbound. This system was installed in January 1981. 15-20 minute delays occurred previously. The system is not in operation southbound during the evening peak hours. A television camera tunnel surveillance system is also in operation. There are ten cameras in the system (five cameras for each direction). The system is a fixed system without the capability of pan and tilt operations. This system has been in operation for at least ten years. The operator of the system also handles the radio communications centre responsibilities.

   e) Exclusive Bus Lane on Highway #99 - An exclusive southbound bus lane is located on Highway #99 from Westminster Highway southerly to the George Massey Tunnel. The length of the exclusive bus lane is 4.8 km (3 miles). Approximately 40 buses per hour utilize the exclusive bus lane. For the six lane section of Highway #99, the following lane layouts occur: three lanes northbound and two lanes southbound with the third southbound lane reserved for bus transit operations.

   f) Pattullo Bridge - A patrol is provided on the bridge. A contract tow truck operation occurs for 15 hours per day.

   g) Port Mann Bridge - A variable message sign system that will utilize five or six preselected messages is under consideration. At present, a contract tow truck operation occurs with the wrecker patrolling the bridge site.

h) Motorist Information System - Several A.M. radio stations now provide information to motorists during the peak travel hours.

6) As part of the construction of the Annacis Freeway, a freeway management system will be installed. A conduit system will be provided. Detectors will be spaced every 600 metres on the mainline of the freeway and will also be located on each of the ramps. The control centre may possibly be located at the first interchange south of the Annacis Island Cable Stayed Bridge. A television camera system consisting of five cameras will be installed in the vicinity of the Annacis Bridge. Variable message signs will be located in the vicinity of the major interchanges. Detectors are being installed on the bridge before the concrete deck is poured. A map of the Annacis Freeway is contained in Appendix I, which provides detailed information on the Annacis Freeway project.

7) The Province may desire to consider a freeway management system on the Burnaby Freeway (Highway #1) from the Port Mann Bridge on the east to Cassiar Street on the west in Vancouver. The Lougheed Highway (Highway #7) offers diversion capability since it parallels Highway #1. Of particular concern is the treatment of the interchange of the Lougheed Highway with the Burnaby Freeway at the Cape Horn interchange. The Province desires to examine possible treatments for managing this traffic in the P.M. peak hours in the vicinity of the eastbound bottleneck at the Port Mann Bridge. The Province noted that during the peak P.M. hours, stop-and-go traffic conditions occur on eastbound Highway #1 from the Cariboo Road interchange easterly to the Port Mann Bridge.

8) The Province noted that the City of Vancouver is installing a computerized signal system that will consist of approximately 400 traffic signals. Construction is expected to be completed prior to the opening of EXPO 86.

At the meeting held on Tuesday, July 9, 1985 with Transport Canada, the Province, and EXPO 86 personnel, discussions centered on the possible implementation of freeway management techniques to assist in the daily operation of this special event.

The following specific items were discussed at the July 9, 1985 meeting relating to EXPO 86:

1) IBM is providing an on-site information system for EXPO 86.

2) The State of Washington is considering installing a diversion system known as "Eye in the Sky" in order to provide information south of the Canadian border to motorists destined to Vancouver and EXPO 86.

3) Information will be disseminated via brochures through the EXPO information offices.

4) A marketing study is being completed that will estimate the total expected attendance.

5) EXPO 86 will require 25 000 parking spaces per day. It is estimated that 10 000 to 12 000 spaces will be available during a weekday in downtown Vancouver. At Glen Road and Miller Avenue, it is expected that 3 000 parking spaces will be leased. A contingency plan will examine possible locations for peripheral parking.

6) Additional buses may serve the ferry points. It is anticipated that 600 charter buses per day could arrive at the site. EXPO has built one parking facility for these charter buses. It is expected that the charter buses will arrive in a two to three hour peak time frame.

7) It is anticipated that 63% of the traffic will arrive from the east and 35% from the south.

8) The peak anticipated daily attendance is 125 000. It is anticipated that the daily attendance could reach 150 000 per day.

9) IN-PARK, a private parking operation, has been given a contract to provide parking for EXPO. This company will operate lots and shuttles to the site. It is anticipated that a subcontract will be provided to a local bus operator.

10) City taxi companies do not want the suburban taxi companies to be allowed to pick up passengers at EXPO. If any additional taxi permits are granted, it is anticipated that they would be temporary permits only for use during the EXPO.

11) A traffic management plan is being prepared by the City of Vancouver. It is anticipated that this plan will be completed by September 1985. It is expected that this plan will cover only the downtown Vancouver area with particular emphasis on the parking needs and traffic signal control coordination. It also expected that the City will turn to the police to provide the additional manpower required.

Although it is recognized that an overall traffic management plan for this special event should be undertaken, none of the involved agencies has been assigned the leading role. Each agency is involved with their particular jurisdictional areas. EXPO is addressing the problems within the EXPO site itself. The City of Vancouver is addressing problems only within the downtown Vancouver area. An overall coordination of the traffic management schemes is not being fully addressed at this time.

MATERIALS RECEIVED FROM THE AGENCIES

The following materials were received from the Province of British Columbia:

1) Package providing information on the Annacis Freeway construction project.

The following materials were received from Ron Rice, Chief of Transportation Systems for EXPO 86:

1) A report entitled "Specialized Periods" dated May 1985 prepared by the Programming Department for EXPO 86.

TOUR OF EXISTING ROADWAYS

On Sunday, July 7, 1985, a tour was made of the Vancouver freeways and local street system by a member of the consultant team. This tour was made to familiarize the consultant team with the specific characteristics of the roadways.

On Tuesday, July 9, 1985, a helicopter tour was made of the Burnaby Freeway. This helicopter tour made it possible for the consultant team to observe the traffic conditions during the P.M. peak hour. In addition, this tour provided the consultant team with additonal insight to the physical and geometric characteristics of the Burnaby Freeway.

A follow-up tour of the freeway and major arterial system was made on Wednesday, July 10, 1986, by the other member of the consultant team.

CONCLUSIONS

As a result of the meetings with the operating agencies and the tour of existing roadways, the following was accomplished:

1) Existing freeway management problems on the Burnaby Freeway were noted.

2) The need for freeway management for the special event of EXPO 86 was noted.

3) The possible solutions to the freeway management problems were discussed.

4) Possible techniques that can be implemented to assist in the managing of the traffic for EXPO 86 were noted. These techniques include items such as the use of highway advisory radio at (a) freeways leading into Vancouver and (b) at the customs check locations at the Canadian/U.S. border, and the establishment of a traffic command center for disseminating information to the motorists on the freeway conditions, available parking locations and transit service.

5) Treatments that have already been applied to attempt to solve the problems on the freeways were examined.

6) Future freeway management projects that are now under consideration by the Province were noted.

7) The possible freeway management system opportunities on the Burnaby Freeway were determined.

8) The highest priority for the application of freeway management systems was determined to be (a) the Burnaby Freeway from the Port Mann Bridge to Cassiar Street, and (b) the Annacis Freeway.

9) The techniques that can be examined in depth for consideration on the Burnaby Freeway include the following:

   a) Implementation of a corridor management system that includes the Burnaby Freeway, the Lougheed Highway, and the interconnecting roadways.

   b) Possible use of the shoulder during peak hour operations and during the EXPO in order to increase the capacity and reduce delays.

10) The two candidate systems should be examined in greater depth under a feasibility study to determine the specific techniques that will provide the required benefits.

Section 2
Toronto, Ontario

MEETINGS WITH OPERATING AGENCIES

Meetings were held with the following staff of the planning and operating agencies within the Toronto metropolitan area:

1) Ministry of Transportation and Communications

Colin A. Rayman, P.Eng.
Head - Freeway Traffic Management Systems Section
Traffic Management and Engineering Office
(14 August 1985 - 13:00)

E. Ryerson Case, P.Eng.
Principal Research Engineer
Research and Development Branch
(15 August 1985 - 12:30)

2) The Municipality of Metropolitan Toronto
Department of Roads and Traffic
Traffic Branch
(15 August 1985 - 10:00)

David B. Richardson, P.Eng.
Senior Traffic Engineer
Research & Investigation Division

Bruce P. Zvaniga, V.A.Sc.
Traffic Engineer
Research & Investigation Division

W. Leslie Kelman, P.Eng.
Senior Traffic Engineer
Traffic Control Centre

Ron W. Stewart, B.A.Sc.
Assistant Engineer
Traffic Control Centre

3) The Municipality of Metropolitan Toronto
Metropolitan Planning Department
(8 September 1985 - 12:30)

A. Richard Gordon, P.Eng.
Director
Transportation Division.

TOPICS COVERED AT THE MEETINGS

The agenda for each of the meetings was as follows:

1) Freeway Management Systems for Transportation Efficiency and Energy Conservation - a briefing on Phases I & II of the study:
   - objectives
   - main products
   - intended audience
   - current status by task

2) Freeway traffic management vis-a-vis the agency's current policies and practices:
   - freeway transportation scene (Task 1)
   - primary constraints
   - current implementation programs
   - future planning

3) Range of applicable freeway management techniques
   - (over-and-above current, committed programs)

FREEWAY TRANSPORTATION SCENE & PRIMARY CONSTRAINTS

Some of the primary issues, constraints and opportunities affecting the decision making on freeway traffic management projects in the Toronto metropolitan area are:

* **Population Growth** - latest population projections call for growth of 1.6M in the next 20 years for Ontario (to 10.6M by 2006), with fastest growth in areas surrounding Metro - i.e., York and Peel regions. Unless the self-containment levels of the regional development centres, and the alternative development foci within Metro itself, improve (to match, or at least approach, the targets of each of the official plans), this population growth will translate to significant additional pressure on the existing road system by long distance commuters who:
  - strain the system for the longest periods;
  - have the least time-flexibility; and
  - are the most likely to use private automobiles.

  With the present uncertainty about which specific transportation investment strategies would best support the self containment polices of the official plans, there is hardly any reduction in sight in the wastefull cross-commuting prevelant throughout the metropolitan area.

* **Railway Lands** - a mammoth $2B development plan, recently accepted by the City of Toronto, will result in some 1.2M m^2 of office space (the equivalent of 25 office towers with 25 stories each), 5000 housing units and a 60000 seat domed stadium at an 80-hectare site in the downtown of the city. The development, and the downtown itself, are constrained on one side by the lake - squeezing the main transporta-

tion demand into a semi-circle of radial facilities closing in on each other (during the morning peak). The related Official Plan Amendment and Zoning By-laws may still end up in the Ontario Municipal Board for a hearing (due to public pressure for additional residential development to replace some of the commercial development).

Despite the expected massive impact on person travel demands (one projection: 50000 new daily inbound commuters alone), the development plan does not yet include any detail traffic or parking management strategies for either the residential, the commercial or the stadium developments, or proper estimates of the related transportation improvement and environmental costs.

* **Transportation Spatial Constraints** - because Toronto and its adjacent cities form a mature metropolitan area, with an extensive transportation network laid over a complex land use pattern, there is little 'loose space' for expanding the present transportation infrastructure in any of the major travel demand corridors. And where there still is some (physical) space available, there has been consistent public and political pressure against any road construction plans or even corridor protection (considered, by many, tantamount to ultimate construction).

* **Transportation Network Constraints** - must be recognized when deciding on major investments in new capacity. For example, it would not be cost effective to increase capacity in one direction or in one specific corridor (e.g., the Hwy #401/ Hwy #7 east-west corridor) on the basis of projected growth in traffic destined primarily into a capacity-restricted direction or corridor (e.g., into the congested north-south arterials which lead into a further congested downtown street network), unless corresponding improvements can be made in these facilities also.

* **Transportation Investment Constraints** - since the 1960's/early 70's haydays of road and transit expansion, transportation investments have faced increasingly severe competition from other sectors of the economy. Many feel that the true significance of these financial constraints has not yet been fully realized. This may change with the emerging debate about the large transportation investments proposed for the Toronto metropolitan area: $3B-$5B new regional rail system; $2.7B metropolitan and local transit improvements called Network 2011; $600M new east-west freeway paralleling close the already biggest freeway in the country. While the attention by both the public and the planning community on these major investments has tended to confuse priorities-setting at a more down-to-earth scale, it may also ultimately highlight the cost-effectiveness of all TSM-type investments: a comprehensive region-wide freeway traffic management system program could be funded by the interest on the capital required for one component of one of these major capital projects.

Because of the above spatial and system realities, and continued severe financial constraints, there is a need (and in due course, perhaps extraordinary public pressure) to first focus on optimizing the operation of the existing transportation infrastructure and service as part of a longer term investment strategy.

CURRENT IMPLEMENTATION PROGRAMS & FUTURE PLANNING

The mandate of the Ministry of Transportation and Communications covers all freeways in the Toronto metropolitan area - except for the Gardiner Expressway and the Don Valley Parkway, which are under Metro's jurisdiction. In the longer term - assuming full cooperation by all regional and local municipalities - an area-wide network approach for developing freeway management strategies may ultimately be possible. At present, however, selected individual sections of the (MTC) freeways are being looked at separately. No freeway traffic management work is yet under way by Metro. The current status of the work undertaken by consultants for MTC is:

* **Macdonald-Cartier Freeway (Hwy #401):** from Winston Churchill Blvd (west of Interchange 336) to Neilson Road (Interchange 385), including a short tie-in section of Hwy #403:
  - Hwy #427-Hwy #404 section: under final design (construction cost approximately $19M)
  - to be operated 24h/d and 7d/w
  - westerly and easterly sections: feasibility study completed - no design effort planned until midsection well in operation
  - all sections: loop detectors installed as part of regular rehabilitation.

* **Highway #401:** from Neilson Road (Interchange 385) to Brock Road (Interchange 399):
  - feasibility/preliminary design study completed
  - no freeway management installation considered necessary due to additional capacity provided by committed core & collector construction.

* **Queen Elizabeth Way:** from Royal Windsor Drive (in Oakville) to Humber River (Mississauga/Etobicoke boundary):
  - ramp metering in place since 1975
  - feasibility/concept design study underway (one issue: how much of current equipment is salvageable).

* **Highways #427 & #403:** both between QEW and Hwy #401:
  - no action at present
  - applicability study planned (as an add-on to the QEW study only).

* **Highway #400 & #404:** both between Hwy #401 and Hwy #7:
  - no action at present or planned.

Possible future enhancements suggested or commented upon, by the agencies' staffs include the following:

* **Information dissemination to the public**
  - by telephone hook-ups to the radio stations (as opposed to other means)
  - so far media has shown little interest - on the other hand, there has been no special effort on the part of any of the agencies responsible for transportation planning to get media interested or involved in any cooperative advisory effort
  - possible advice to drivers on freeways about available TTC parking rejected (parking info not on-line and on some days, some priority incident might not allow advisory signing).

* **Ramp metering along Highway #401**
  - to be considered (due to QEW experiences) only after
    - experience accumulated on handling the committed core-collector diversion
    - public acceptance of the above.

  Note: this concept does not include signs prior to ramps advising drivers on the arterials to take any specific alternative routes. (Leslie St. ramp will include an experimental core/collector entry advisory).

* **Highway advisory radio**
  - no plans due to
    - political decision made not to 'compete' with radio stations
    - assumed, poor frequency availability.

* **Incident management**
  - MTC provides information to police (where CCTV capability or if incident spotted by courtesy patrols)
  - police will coordinate everything, e.g., call central tow truck companies' number who will dispatch from a rotating list (pirates still claimed to be a problem)
  - occasional requests for MTC to handle all, but no plans.

* **Preferential treatment of high occupancy vehicles**
  - nobody has assumed the responsibility for marketing the concept or coordinating an area-wide effort
  - the analytical technique of 'person throughput' has not been accepted by local traffic engineers and transportation planning staff, who still use 'vehicle capacity' (i.e., treat all vehicles alike, independent of number of occupants).

* **Corridor control**
  - no plans for any foreseeable future
    - freeway and area traffic controls will stay separate
    - Metro is not installing any detectors, as part of their reconstruction program, in anticipation of possible corridor control
  - preliminary commitment to exchanging data (via display terminals at each control centre)
  - possible arterial signal timing plans to better accommodate traffic which may elect to divert from the freeways (without having been so advised).

FREEWAY TRAFFIC MANAGEMENT PRIORITIES IN METROPOLITAN TORONTO

Based on reviews undertaken for Task 1, on interim meetings held throughout the study with various MTC staff and the reviews and discussions related to this Task 9, the following have been identified as priority freeway management projects for which an applicability/concept design study or a feasibility/preliminary design study should be undertaken:

1) **The Gardiner Expressway - Lake Shore Boulevard Corridor Diversion & HOV System**

   Primary Features

   - motorist advisory on road and traffic conditions on major parallel facilities (Gardiner Exwy/Lake Shore Blvd/The Queensway/Dundas St. (Hwy #5)/Bloor St./...)
   - preferential treatment of HOVs: exclusive lanes and entry and exit ramps/CBD parking/TTC and Go Transit parking/...
   - reversible lane(s) on sections of Lake Shore Blvd
   - tie-in with QEW system in the west and with Don Valley system in the east (both including by-pass access ramps for HOVs)
   - tie-in with downtown grid system in the middle:
     - reversible lanes and streets
     - changeable advisory signs on arterials near freeway entry ramps

- tie-in with comprehensive traffic mitigation strategy for the railway lands residential and commercial developments
- tie-in with an on-line parking access/availability system for the (Domed Stadium/Canadian National Exhibition/Ontario Place) special events

Traffic Components

- recurring commuter congestion
- non-recurring commuter incident/weather congestion
- off-peak recreational traffic destination-searching
- special events congestion.

2) **Queen Elizabeth Way Corridor Management System**

Primary Features:

- motorist advisory about road and traffic conditions, and about alternative routing options, on major:

parallel facilities	crossing arterials
- Lakeshore Road	Erin Mills Pwy/Southdown Rd
- QEW	Mississauga Rd
- The Queensway	Hurontario (Hwy #10)
- Dundas Street (Hwy #5)	Cawthra Rd
- Burnhamthorpe Road	Dixie Rd

- preferential treatment of HOVs:
  - park-and-ride lots near and at the major interchanges
  - Go Transit parking
  - priority entry onto QEW mainline through HOV by-pass ramp lanes
  - contra-flow HOV lane: 3 hour am & pm peak operation - except in severe inclement weather
- tie-in with the Gardiner-Lake Shore Corridor Diversion and HOV System, e.g.:
  - exclusive freeway exit ramps to enter downtown
  - CBD parking nearest to employment concentrations exclusive to HOVs
- tie-in with a single point diversion system between Oakville and the northwest corner of Metro (Hwy #427/Hwy #401 interchange):
  - QEW-Hwy #427 routing vs. Hwy #403-Hwy #401 routing.

3) **HAR in Selected Corridors**

Primary Features:

- coordinated detection/verification system: CN Tower zoom cameras/ CB radio detection and remote monitoring/radio stations' helicopters

and small planes/MTC courtesy and police patrols/detection loops and CCTV along Gardiner-Lake Shore corridor/arterial signal control detectors/ voluntary and contract and on-call stationary observers

- coordinated advisory system: regular radio channels/special HAR channels (cable radiator antenna)/tie-in with corridor changeable message signs/...
- coordinated response system: incident response teams by major section/special access-use of reversible lanes/...

4) **Pre-Trip Planning Service**

Primary Features:

- coordinated traffic information reporting system at major employment complexes in downtown Toronto, e.g.:
  - King & Bay: TD Centre & Bank of Montreal & Commerce Court & Scotia Bank Plaza
  - Railway Lands commercial development concentration
- coordinated traffic information reporting system at major private and municipal parking garages
- provision of up-to-the-minute, visual freeway situation reports to local cable TV networks for home-end alternative travel time/route decisions
  - test project focus: QEW-Gardiner corridor

5) **Don Valley Parkway Motorist Advisory System**

Primary Features:

- coordinated traffic/incident/weather information reporting system for drivers about to enter or who already are on the Don Valley Parkway
- preferential treatment of HOVs: primarily at the ramps (possibility of an HOV contra-flow lane to be re-reviewed recognizing full corridor capacities, and differences in alternative routing options during peak vs. off-peak)
- tie-in with: #3 HAR in Selected Corridors
  #4 Pre-trip Planning Service.

TABLE 14

MATERIALS RECEIVED FROM THE AGENCIES
- Toronto, Ontario -

DON VALLEY CORRIDOR TRANSPORTATION STUDY

M.M. Dillon Limited, Metropolitan Toronto Technical Transportation Planning Committee, July 1983.

KEY FACTS . . . THE MUNICIPALITY OF METROPOLITAN TORONTO

Metropolitan Toronto Planning Department, April 1984.

OFFICIAL PLAN FOR THE URBAN STRUCTURE - THE METROPOLITAN TORONTO PLANNING AREA

Metropolitan Clerk's Department, February 1984.

NETWORK 2011 - A RAPID TRANSIT PLAN FOR METROPOLITAN TORONTO

R.K. Wanless/Marshall Macklin Monaghan Ltd. & M.A. Tedesco/Barton Aschman Associates Ltd., Toronto Transit Commission, May 1985.

BURLINGTON SKYWAY FREEWAY TRAFFIC MANAGEMENT SYSTEM
Preliminary Design Report

H. Wong/IBI Group, Traffic Management and Engineering Office/MTC, July 1982.

METROPOLITAN ATLAS SERIES - TORONTO
1981 Census of Canada

Statistics Canada Catalogue 99-919, ISBN 0-660-51258-0, July 1984.

STEPS OF THE PROJECT IMPLEMENTATION

PURPOSE

The purpose of Task 10, Steps For Project Implementation, was to review the various steps necessary to accomplish the implementation of a freeway management system. The possible constraints that should be recognized and addressed in order to initiate a project were identified. Also, the need to gain the participation and cooperation of all agencies and groups which have a direct interest in the freeway management system, was emphasized. Necessary support programs that should be initiated to ensure the successful development, installation and operation of a freeway management project were outlined. In recognition of these steps, a tentative program and schedule for the implementation of the Decarie-Metropolitan Expressway Corridor Management Project in Montreal were prepared.

FIVE PRIMARY STEPS

The implementation of a typical freeway management system is a complex undertaking which consists of the following five primary steps:

- identification of problems and objectives
- evaluation of feasibility
- design and construction
- integration and operation and maintenance
- monitoring and evaluation and enhancements.

The development and operational phases for a freeway management project - with a short description of the main activities - are presented in more detail in Table 15.

During the feasibility phase - an overall freeway management plan, covering the entire metropolitan area, should be developed and evaluated. This will facilitate identification of the best staging plan and preliminary optimization of the timing for these stages. It can prevent serious, costly problems rising later when the first stage is to be expanded or when the freeway management system is to be connected with the area traffic control.

TABLE 15

DEVELOPMENT & OPERATIONAL PHASES
OF FREEWAY MANAGEMENT SYSTEMS

PROJECT PHASE	DESCRIPTION
1. Awareness and Identification of Problem	Recognition of problems, and preliminary identification of possible freeway management system approaches
2. Planning Applicability Study	Examination of specific freeway management techniques which may be implemented to address the problems - based upon site specific conditions
3. Feasibility Study	In-depth examination of alternative techniques, and recommendation of a preferred system of techniques for implementation
4. Design of Plans, Specifications and Estimates	Preparation and design of plans and specifications, and development of cost estimates for the selected system
5. Bid Selection	Determination of qualifications of contractors, invitation of bids, and selection of winning bid
6. Construction	Engagement of qualified construction firm and equipment suppliers, and installation of all system components
7. Construction Inspection	Supervision of the contractor, and inspection of quality of construction and type of equipment to assure that all work and installed equipment meet their specifications
8. Consultant Selection	Determination of the use of Request for Proposals, or a designation process to select a consultant -if necessary- for the following phases: - system integration & acceptance testing - system operation - system maintenance - system evaluation - system enhancements
9. System Integration and Acceptance Testing	Preparation of system software programs, and testing of performance to assure acceptable operation of the total system and all of its components
10. System Operation	Establishment of management structure and procedures, and staffing of the day-to-day management and control of the system
11. System Maintenance	Provision of necessary equipment and staffing to maintain all components in the field and at the control centre
12. System Evaluation	Development and selection of specific measures of effectiveness (MOEs), carrying out of continuous or periodic monitoring, and determination of the performance of the system and its elements
13. System Enhancements	Identification of system deficiencies, and development and selection of additional management applications and techniques which will support and enhance the overall operation of the system

IDENTIFICATION OF CONSTRAINTS

In setting up the phases of a freeway management system, many factors must be considered - to avoid starting more at once than is practical and achievable:

* technical constraints: system continuity; physical restrictions in the plant; components and their limitations;...
* technical opportunities: synergistic effect through complementary incentive/disincentive measures; 'stringing' of measures; near-term technology advances;...
* financial constraints: money securable on time from all participants; competing priorities, different within each agency;...
* jurisdictional constraints: resistance to ramp control strategies; resistance to alternative routes; concern over revenue and cost sharing on regional/local transit;...
* user support: immediate, documentable benefits; HOV preference over SOVs justifiable and reasoned; careful timing of incentives vs. disincentives;...

In selecting specific management approaches and detection/verification/response and control techniques for inclusion in each stage, the planners and traffic engineers will need to:

* be aware of major issues which are going to influence the decision making process (e.g., as above and Table 16)
* select priority goals and objectives for the overall project and its stages - while recognizing the constraints and opportunities of each implementation site (e.g., Table 16)
* seek maximum return on investment through innovative packaging and stringing of complementary management measures (e.g., Table 17)
* recognize the special thrusts of each of the development phases of the project (Table 15); and
* seek the participation of all relevant agencies.

PARTICIPATION

In order to assure that a project may progress as smoothly as possible at each phase of its development, it will be important to gain the participation and cooperation of all agencies and groups which have a direct interest in the freeway management system. This involvement should begin at the earliest phases of development, already during problem identification - and continue throughout the project, including its monitoring, evaluation and enhancement phases.

TABLE 16

SITE SPECIFIC CONSTRAINTS AND OPPORTUNITIES

ISSUE	EXAMPLES
• Geographic Layout	• Rivers (Bridges) • Mountains (Tunnels)
• Environmental Effects	• Ice and snow complicating, on some days each year, replacement of HOV lane indicator cones • Severe fogging on a highway section requiring advance driver warning • Rock slides on long mountain road stretches requiring advance driver information
• Jurisdictional Responsibilities	• Coordination of municipal, provincial and federal interests • Adjacent developments restricting construction of a continuous exclusive high occupancy vehicle (HOV) through-lane
• System Wide Constraints	• Parallel facilities not capable, without major traffic operations improvements, of absorbing diverted traffic • Addition of CBD parking, to handle continued growth in single occupant vehicle (SOV) traffic, not possible • Adjacent developments restricting construction of a continuous exclusive high occupancy vehicle (HOV) through lane
• Planning Realities	• Unfamiliarity, by many planners and engineers, with innovative and perhaps all freeway management techniques • Lack of confidence, that strong TSM measures (eg. exclusive HOV ramps in CBD) can be "sold" to decision makers • The common misconception that traffic can grow (as per 'models') beyond the practical throughput capacity of a corridor
• Political Realities	• Opinion that ramp metering penalizes localities closest to the city (and favours proliferation of wasteful long distance commuting) • The 'invisible' freeway management measures still not as popular as grand schemes of road and transit improvements • Pressure to turn on operation before system is fully tested • Lack of determination to carry through in the face of vocal opposition (nearness of elections)
• Public Realities	• Drivers of SOVs not in agreement with the economic and social rationale that 4 taxpayers in one vehicle (=carpool) deserve preferential treatment compared to 1 taxpayer in one vehicle • Strong support from environmental and neighbourhood groups for freeway management systems which help prevent construction of more major roadways.

TABLE 17

COMPLEMENTARY PACKAGES

- Two Examples -

STRATEGY	COMPLEMENTARY PACKAGE
- Incident Management	- On-site incident management team - Loop detection - Verification — remote CB radio monitors; CCTV - Motorist aid — call boxes - Response — courtesy patrols; tow trucks; medical emergency teams - Clearance — tow trucks - Control — variable message signs; highway advisory radio; alternative routing - News dissemination — radio, TV, papers; pre-trip planning
- HOV Preferential Treatments	- Metropolitan fringe park-and-ride lots near major interchanges - Priority entry onto freeway mainline through HOV by-pass lanes and ramps - Concurrent or contraflow lane on freeway reserved for buses, vanpools and carpools - Exclusive freeway exit ramps for HOVs to enter downtown - CBD parking: municipal lots/garages nearest to major employment concentrations designated exclusively to HOVs from 6 a.m. to 11 a.m. (Monday to Friday)

Depending upon whether the project is located in a metropolitan or rural area, the number of involved agencies and groups will vary considerably. These can include specific research, planning, design and operations units within several ministries or departments of the provincial and federal governments and within two levels of municipal government - as well as numerous private enterprises: consultants, carriers and various associations. A steering committee, consisting of representatives of those agencies and groups, is usually set up to oversee the project management and to provide a forum for consultation and coordination throughout the project.

The agencies and groups potentially involved in freeway management systems, in Canada and the United States, are listed in Tables 18 and 19.

NECESSARY SUPPORT PROGRAMS

The implementation of innovative transportation solutions is frequently hindered by certain professional reluctance, organizational inertia, and political indifference. In the case of freeway management systems, there are many reasons for this:

* freeway management systems can, in strictly technical terms, be much more complicated to plan and implement than new road construction;
* freeway management systems include modern planning and analytical concepts, with which many transportation planners and traffic engineers are unfamiliar or uncomfortable - e.g.:
  - demand management (not just fine tuning the supply or 'improving traffic flow')
  - preferential and exclusive treatment of high occupancy vehicles (not treating all vehicles alike)
  - 'person throughput capability' (not just 'vehicle capacity') - calculated for a corridor of parallel facilities (not just for the freeway), with full utilization of throughput buffers provided by different peak lengths on the parallel facilities
  - alternative work schedules offered by employers to enable use of peak shoulder capacity in both transit and the road system
  - etc.;
* the experience of senior staff in transportation planning agencies is typically concentrated on the 1960s/early 70's-type route feasibility studies and design of new roadways;
* freeway management systems are perceived to lack the 'political opening grandeur' of new freeways.

TABLE 18

AGENCIES & GROUPS INVOLVED IN FREEWAY MANAGEMENT SYSTEMS
- CANADA -

FEDERAL GOVERNMENT	MUNICIPAL GOVERNMENTS (Regional & Local)
* Transport Canada - Transportation Development Centre - Surface Policy Planning & Urban Programs - Highway Transportation - Road & Motor Veh. Traffic Safety * Energy, Mines & Resources Canada - Transportation Energy Division * Environment Canada - Environmental Protection Service - Parks Canada * Indian & Northern Affairs Canada - Tech. Services & Contracts Branch	* Traffic and Roads Department(s) * Transportation Planning Dept. * Transit Operator(s) * Parking Authority * Municipal Police (& RCMP)
PROVINCIAL GOVERNMENT	PRIVATE SECTOR
* Ministry of Transportation & Communications; or * Department of Highways & Transportation H.Q./Regional/District Offices - Research & Development - Transportation Energy - Urban Transportation Planning - Transit Planning - Traffic Management & Engineering - Highway Programming - Communications - Engineering & Right of Way - Contract Management - Construction - Maintenance Operations - Safety * Provincial Police (Solicitor General) * Ministries of Environment & Energy	* Tow Truck Operators * Car & Van Pool Associations * Taxi Association(s) * Intercity Bus Association * Provincial (& Canadian) Trucking Association * Parking Facility Operators * Automobile Clubs * Chamber(s) of Commerce * News Media * Contractors - Construction - Maintenance * Consultants - Research - Planning - Design - Operations & Mgt * Others (as required)

TABLE 19

AGENCIES & GROUPS INVOLVED IN FREEWAY MANAGEMENT SYSTEMS
- UNITED STATES -

FEDERAL GOVERNMENT	STATE AND LOCAL GOVERNMENTS
* Federal Highway Administration - Office of Traffic Operations - Traffic Engineering Division - Signals, Communications & Lighting Division - ... - Office of Safety & Traffic Operations Research & Development - Urban Traffic Management Div. - Safety and Design Division - ... - Regional Office - District Office * Urban Mass Transportation Admin. - Office of Service & Mgt Demonstrations - ...	* State Depart. of Transportation - Regional Office & Main Office * City Department of Transportation * County Department of Public Works * State Parks & Recreation Commmission * State Office of General Services * Police - State - County - City - Village * Local Metropolitan Planning Organization * Regional State DOT Groups - Traffic and Safety Group - Maintenance Group - Planning Group - Design Group - Oil Spills Group - Construction Group - Operating Group
PRIVATE SECTOR	
* Consultants - Systems integrator - Evaluation - Planning & design - Operations * Contractors - Construction - Maintenance * Franchise Tow Truck Operators * Others (as required)	

The reluctance to plunge into something new and more complicated is perhaps quite understandable. The selection of innovative TSM alternatives still requires, in many agencies, more careful justification and nurturing than proposing conventional new construction. Many potentially excellent, cost-effective proposals have faltered - and even been removed from the system after their implementation - due to lack of carefully planned support programs. There is a need to 'sell' these projects: to make sure that sound technical evidence on their financial, transportation access and safety, energy and environmental benefits is developed - and then fully transmitted to the decision makers. Several support plans are required to ensure the successful development, installation and operation of any freeway management project:

* marketing plan - to enlist the support of management personnel and political decision makers
* public relations plan - to communicate with news media, freeway corridor users and the public-at-large
* staging plan - to split the project into technically, financially and politically manageable stages
* funding plan - to budget and obtain sufficient funds from all contributing agencies for each stage in a timely fashion
* educational plan - to increase the expertise of agency staff and the knowledge of others involved in the project
* operating and management plan - to provide staff with step-by-step approach for the day-to-day operation and maintenance of the system and its components
* research plan - to monitor and advance the state-of-the-art in freeway management techniques and devices, and to establish contacts with managers of other projects in order to share experiences and avoid 're-inventing the wheel'
* monitoring and evaluation and enhancement plan - to monitor the performance of the adopted strategies and elements, to measure the cost-effectiveness and efficiency of the system, and to identify necessary improvements.

IMPLEMENTATION STEPS FOR THE SELECTED PROJECT IN MONTREAL

In order to implement a traffic management system in the freeway corridor that includes the Metropolitan Expressway and the Decarie Expressway, the Province of Quebec will need to undertake steps 3 through 13 (Table 15) - steps 1 and 2 have already been completed as part of the Freeway Management

Systems for Transportation Efficiency and Energy Conservation project. Before initiating the feasibility study, the following is required:

* Form a Steering Committee to oversee and guide the project through the various development phases as indicated in Table 15. It should be comprised of selected members of government agencies (Table 20) with information disseminated to the private sector groups. This Steering Committee should also gain the input and participation of the various local agencies in order to ensure the success of the project.

* Seek funding for a feasibility study. The search for funds should include the following sources: (1) Transport Canada, (2) Energy, Mines and Resources Canada, (3) Province of Quebec, (4) the City of Montreal, and (5) the joint research and development agreements of the federal and provincial governments.

  The first task during the feasibility study would be to prepare a detailed project plan and schedule. This will first require an agreement on the methodology to be used. For example, during the feasibility study for the IMIS project on Long Island, New York, extensive computer simulations were used to determine the expected benefits of the system. That approach is not considered appropriate for the Decarie-Metropolitan Freeway Corridor Management System. A much simpler (manual) assessment approach should be used - to determine the order-of-magnitude benefits likely to be derived from alternative systems and alternatrive control strategies. Linear scoring function techniques can then be used to compare the cost-effectiveness of the alternatives in terms of a wide range of variables, including reduction in travel times, incidents and emission of air pollutants. A preliminary list of steps for the feasibility study is presented in Table 21. A detailed outline of data requirements is provided in Table 22.

A tentative schedule for the implementation of the Decarie-Metropolitan Freeway Corridor Management System is presented in Figure 4. This schedule is very preliminary, and will need to be modified based on the specific traffic management requirements and priorities of the province and other participants, and based on the availability of resources. Adherance to the step-by-step procedures described earlier will greatly assist in making the planning and implementaiton process as responsive and cost-effective as possible.

TABLE 20
DECARIE-METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM
- Agencies & Groups -

FEDERAL GOVERNMENT	MUNICIPAL GOVERNMENTS
* Transport Canada - Transportation Development Centre * Energy, Mines & Resources Canada - Transportation Energy Division PROVINCIAL GOVERNMENT (Gouvernement du Québec) * Ministry of Transportation (Ministère des Transports) - Project Planning (Direction des tracés et projets - Division circulation et aménagements) - Traffic Operations (Direction régionale 6-3: Centre T.V.M.) - Research & Development (Direction de la recherche) - Provincial Police (Sûreté du Québec) - Public Transportation (Direction générale du transport terrestre des personnes) - Communications - (Direction des communications)	* Ville de Montréal - Service de la circulation * Ville d'Anjou * Cité de St. Leonard * Ville de Montréal Nord * Cité de Saint-Laurent * Ville Mont Royal * Ville d'Outremont * Ville de Hampstead * Westmount * Montreal Urban Community Transit Commission (La Société de transport de la Communauté urbaine de Montréal (STCUM)) - Service de la Planification generale - division des Recherches * Municipal Police - Le Service de police de la Communauté urbaine de Montréal (SPCUM)
PRIVATE SECTOR	
* Tow Truck Operators * Parking Operators * Car & Van Pool Associates - Covoiturage Québec Inc. - L'Association Canadienne des opérateurs de Covoiturage par fourgonnette * Provincial Trucking Association (Association du Camionnage du Québec) * Automobile Clubs: Montreal & CAA * News Media: TV, Radio, Newspapers	

TABLE 21

DECARIE-METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM
- Feasibility Study Steps -

- Preparation of Project Plan and Schedule
  - methodology, work plan and schedule
- Initial Screening of Routes
  - severity of traffic conditions, usefulness in mgt. system, jurisdictional issues, politics realities
- Assembly of Data Base & Problem Identification
  - traffic volumes
  - travel times, speeds, & delays
  - accident & incident data
  - vehicle classification & occupancy
  - O & D data
  - intersection control & operations
  - planned construction & major rehabilitation
  - traffic generated by future developments
- Analysis & Ranking of Alternative Routes
  - location, length, travel time, capacity, available capacity, constraints
- Selection of Roadway Network
  - corridor widths, parallels, alternatives
  - overall management concept
- Refinement of Control Area Boundaries
  - partition corridor into subnetworks
  - control volume-shift capability by section
- Determination of System Function and Control Policy
  - preferences and constraints
  - interfacing with Montreal signal system & other local systems
  - interfacing with existing tunnel T.S. & C.
- Selection of Equipment
  - types, configurations, sourcing, costs
- Development of Alternative Preliminary System Designs
  - integrate sub-system designs
  - develop alt. system configurations
- Finalization of System Costs
  - capital, maintenance, operating costs
- Feasibility Evaluation
  - summarize costs and benefits of alternative systems
  - comparison
- Monitoring & Evaluation Plan
  - select MOEs
  - identify procedures

TABLE 22

DECARIE-METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM
- Data Requirements -

* physical inventory: maps & plans
  - freeway mainline/service roads/ramps
  - major arterials/intersections

* intersection control & operations
  - signal system and controller inventory
  - timings
  - communications options

* traffic volume counts: permanent count stations & special counts
  - AADT/weekday/peak & off-peak
  - directional flows & lane occupancy
  - ramp counts
  - turning movements: major arterial intersections
  - flow variations across corridor (freeway + parallels)
  - special events & incidents & transit strikes & inclement weather

* vehicle classification: sampled by weekday & time of day

* vehicle occupancy: cars & vans

* transit: routes/frequency/load factors (peak & off-peak)

* travel time, speed & delay by segment (floating car)
  - severity & duration of congestion

* density contours by distance and time of day

* accident data
  - number/type/location/duration/response time
  - two year summary/seasonal/weekday/holiday

* incident data: number/type/location/duration
  response times: police & ambulance & tow trucks

* O&D data
  - within metropolitan road system
  - ramp to ramp distribution (license plate survey)
  - weaving at interchanges
  - transit ons & offs

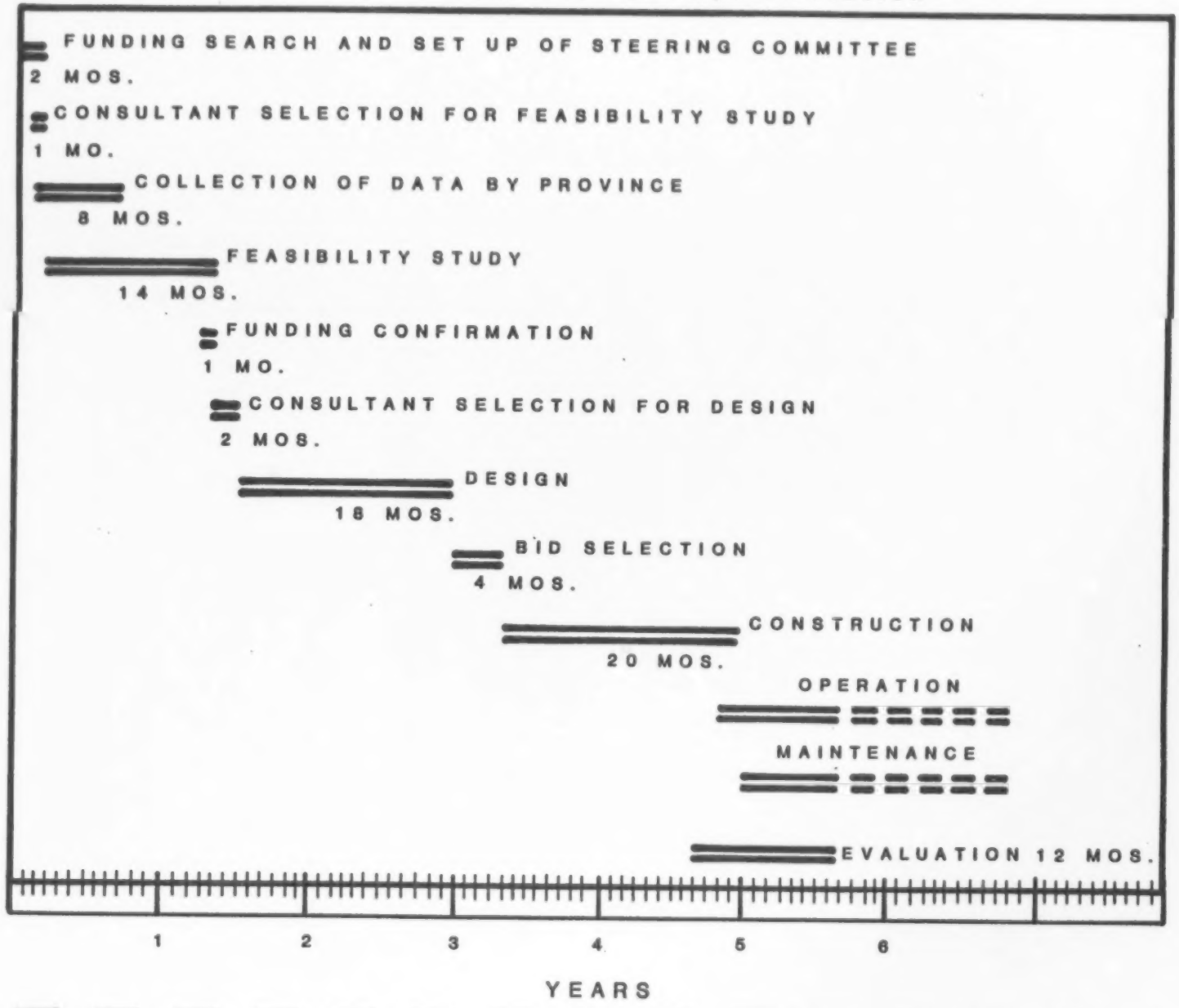
* planned construction & major rehabilitation
  - programs & schedules
  - impact on capacities & alternative routes

* future land development
  - traffic generation (note: on-site HOV assumptions)
  - relation to freeway corridor & management approach

FIGURE 4

DECARIE-METROPOLITAN FREEWAY CORRIDOR MANAGEMENT SYSTEM

— Tentative Schedule for Implementation —



APPENDIX A

HIGHLIGHTS OF VANCOUVER REVIEW

V A N C O U V E R

- SITUATION SUMMARY -

- GEOGRAPHIC LAYOUT
  - COASTAL PLAIN DISSECTED BY INLETS AND RIVERS
  - BOUNDED ON NORTH BY MOUNTAINS

- TRAFFIC IMPACT
  - WATER BARRIERS LIMIT CROSSINGS (ROADS, BRIDGES, TUNNELS) WITH CONGESTION PRESENT
  - EXPENSIVE TO OVERCOME PHYSICAL BARRIERS BY EXPANSION AND NEW CONSTRUCTION
  - NETWORK LENDS ITSELF TO USE OF FREEWAY MANAGEMENT TECHNIQUES

- GENERATORS
  - COASTAL SEAPORT, RAIL AND TRUCK TERMINUS, INTERNATIONAL AIRPORT (SEA ISLAND), CBDs

- TRAVEL NEEDS
  - INTERNATIONAL, NATIONAL AND PROVINCIAL TRAVEL BETWEEN REGION AND OUTSIDE AREAS
  - REGIONAL TRAVEL ACROSS MUNICIPAL BORDERS
  - LOCAL TRAVEL WITHIN A MUNICIPALITY

- TRAVEL MODES
  - AUTO, TRUCK, BUS, FERRY, ALRT SKYTRAIN

- JURISDICTIONS
  - PROVINCIAL MINISTRY OF HIGHWAYS, GREATER VANCOUVER REGIONAL DISTRICT (GVRD), MUNICIPALITIES (13)

- MAJOR TRAFFIC GENERATORS
  - DOWNTOWN VANCOUVER, NORTH VANCOUVER, NEW WESTMINSTER, (LIVEABLE REGION PROGRAM WITH EMPHASIS ON LIVING CLOSE TO WORK)
  - MAIN EMPLOYMENT IN CENTER MUNICIPALITIES
  - DISPERSION OF SUBURBAN RESIDENCES
  - WEST VANCOUVER, RICHMOND, COQUITLAM, AND PORT COQUITLAM

- REVIEW OF ROADWAY MAPS
  - MILITARY CITY MAP
  - POTENTIAL 5 YEAR IMPROVEMENTS (1978)
  - PROVINCIAL HIGHWAY (1978)
  - MUNICIPAL ARTERIALS AND PROVINCIAL HIGHWAYS

- REVIEW OF TRAFFIC OPERATIONS REPORT
  - 1978 5 YEAR PROGRAM 1983

- PROVINCIAL HIGHWAYS (FREEWAYS)
  - #1 TRANS-CANADA HIGHWAY (4 LANES) FROM EAST - TERMINATES IN VANCOUVER CITY LIMITS AT CASSIAR STREET BUT RESUMES AT THE SECOND NARROWS BRIDGE AND CONTINUES TO HORSESHOE BAY (WITH THE EXCEPTION OF THE SEGMENT LONSDALE TO WESTVIEW, WHICH HAS AT-GRADE INTERSECTIONS)
  - #99 FROM OAK STREET BRIDGE THROUGH GEORGE MASSEY (DEAS ISLAND) TUNNEL TO U.S. BORDER AT BLAINE

- NORTHERN CROSSINGS
  - #1A & 99 - LIONS GATE BRIDGE -- NO. 2 ON MAP ON PAGE A-7
  - #1 - SECOND NARROWS BRIDGE -- NO. 3 ON MAP
  - SEA BUS (PASSENGERS ONLY) - FROM LONSDALE TO GRANVILLE

- SOUTHERN CROSSINGS TO DOWNTOWN -- NO. 4 ON MAP
  - BURRARD BRIDGE
  - GRANVILLE BRIDGE
  - CAMBIE BRIDGE
  - GEORGIA VIADUCT

- ADDITIONAL SOUTHERN CROSSINGS -- NO. 5 ON MAP
  - ARTHUR LAING BRIDGE (MUNICIPAL STREET)
  - OAK STREET BRIDGE (#99)
  - KNIGHT STREET BRIDGE
  - QUEENSBOROUGH BRIDGE
  - PATTULLO BRIDGE (#99A, #1A)
  - PORT MANN BRIDGE (#1)
  - PITT RIVER BRIDGE (#7)
  - GEORGE MASSEY TUNNEL (#99)
  - ANNACIS BRIDGE (PROPOSED #91, OPEN SUMMER 1986)

V A N C O U V E R

- POSSIBLE FREEEWAY MANAGEMENT OPPORTUNITIES -

- PERIPHERAL PARKING LOTS FOR BUS OPERATIONS
  - CAPILANO (ROUTE 1A, 99) - NORTH OF LIONS GATE BRIDGE -- NO. 1 ON MAP ON PAGE A-7
  - VANCOUVER P.N.E. AREA (HASTINGS STREET)
  - SURREY/SCOTT ROAD AT KING GEORGE HIGHWAY (#1A & #99A)

- HOV
  - LIONS GATE BRIDGE (REVERSIBLE THIRD LANE) -- NO. 2 ON MAP
  - GEORGE MASSEY TUNNEL - CONTRA FLOW LANE NORTHBOUND IN A.M. PEAK ONLY; SOUTHBOUND (BUS ONLY) LANE FROM WESTMINSTER HIGHWAY TO STEVENSON HIGHWAY

- FREEWAY INCIDENT MANAGEMENT TEAMS

- BRIDGE SURVEILLANCE SYSTEMS
  - #99, 1A - LIONS GATE BRIDGE -- NO. 2 ON MAP
  - ANNACIS BRIDGE

- DRIVER INFORMATION AND ROUTE DIVERSION (HAR)
  - NORTHERN CROSSINGS -- NOS. 2 & 3 ON MAP
  - SOUTHERN CROSSINGS TO DOWNTOWN -- NO. 4 ON MAP
  - ADDITIONAL SOUTHERN CROSSINGS -- NO. 5 ON MAP

- INCIDENT MANAGEMENT SYSTEMS (FREEWAYS)
  - #1 TRANS CANADA HIGHWAY (4 LANES)
  - #99 TO SOUTH (OAK STREET BRIDGE)

- FREEWAY SURVEILLANCE AND CONTROL SYSTEMS
  - ANNACIS FREEWAY -- NO. 6 ON MAP
  - BURNABY FREEWAY (HIGHWAY #1) -- NO. 7 ON MAP

- CORRIDOR SYSTEM
  - BURNABY FREEWAY CORRIDOR (BURNABY FREEWAY & LOUGHEED HIGHWAY) -- NOS. 7 & 8 ON MAP

- PRE-TRIP PLANNING SYSTEMS
  - TELEPHONE CALL-IN NUMBER
  - TRAFFIC INFORMATION REPORTING SYSTEM IN DOWNTOWN MAJOR GENERATORS

- SPECIAL EVENT MANAGEMENT FOR EXPO 86
  - ESTABLISHMENT OF PERIPHERAL PARKING LOTS FOR TRANSFER OF TRAVEL MODE FROM AUTOMOBILES TO SPECIAL BUSES, LIMOUSINES, VANS
  - USE OF HIGHWAY ADVISORY RADIO & TEMPORARY SIGNING
  - TRAFFIC INFORMATION DISPLAYS AT EXPO LOCATIONS
  - ESTABLISHMENT OF DIRECTIONAL & REVERSIBLE FLOW LANES OR STREETS FOR ALL VEHICLES DURING PEAK HOURS & WEEKENDS

LOCATIONS OF POSSIBLE FREEWAY MANAGEMENT OPPORTUNITIES

-VANCOUVER-

NOTE:

SEE PAGES A-4 AND A-5
FOR DESCRIPTION OF
LOCATIONS IN EACH ☐

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APPENDIX B

HIGHLIGHTS OF TORONTO REVIEW

T O R O N T O

- POSSIBLE FREEWAY MANAGEMENT OPPORTUNITIES -

- o SINGLE POINT DIVERSION SYSTEM (Map on Page B-5 and No. 1 on Map on Page B-4)
  - o HIGHWAY 403/401 COMBINATION VS. QEW/HWY. 427 COMBINATION FROM FORD DRIVE IN OAKVILLE TO N.W. CORNER OF TORONTO (VMS, HAR, INCIDENT DETECTION AND MANAGEMENT)

- o CORRIDOR MANAGEMENT SYSTEM (Map on Page B-6 and No. 2 on Map on Page B-4)
  - o LAKESHORE ROAD, QEW, QUEENSWAY, HWY. 5 (DUNDAS ST.), BURNHAMTHORPE ROAD, AND NORTH/SOUTH ROADS AT INTERCHANGES (ARTERIAL SIGNAL COORDINATION SYSTEMS ON ARTERIALS, HAR ON ARTERIALS TO ATTEMPT TO AVOID DRIVING N/S TO FREEWAYS)

- o HOV LANE (No. 3 on Map on Page B-4)
  - o QEW CONTRA-FLOW FOR BUSES, LICENSED VANPOOLS AND CARPOOLS (No. 3A on Map)
  - o DON VALLEY PARKWAY CONTRA-FLOW (No. 3B on Map)

- o HOV BY-PASS RAMPS (No. 4 on Map on Page B-4)
  - o WITHIN MISSISSAUGA ON QEW

- o HOV EXCLUSIVE RAMPS (No. 5 on Map on Page B-4)
  - o ENTERING CBD FROM GARDINER EXPRESSWAY (HWY. #2) - ONE FROM EACH DIRECTION

- PRE-TRIP PLANNING
  - TRAFFIC INFORMATION REPORTING SYSTEM AT MAJOR EMPLOYMENT COMPLEXES IN DOWNTOWN TORONTO (EXAMPLE: TORONTO DOMINION CENTRE FOR ALL THE COMMERCIAL COMPLEXES AT THE KING STREET & BAY STREET INTERSECTION THAT INCLUDES (A) TD CENTRE, (B) BANK OF MONTREAL, (C) COMMERCE COURT, AND (D) BANK OF NOVA SCOTIA PLAZA (SCOTIA BANK PLAZA)
  - INFORMATION TO CABLE TV IN OAKVILLE AREA FOR VISUAL PRESENTATION OF TRAFFIC CONDITIONS

- FREEWAY INCIDENT MANAGEMENT TEAMS

- DRIVER INFORMATION AND DIVERSION
  - VARIABLE MESSAGE SIGNS ON ARTERIALS DOWNTOWN AND NORTH AND SOUTH OF RAMPS ON HWY. 401 TO DIVERT SHORT DISTANCE TRAVELLERS TO LOCAL ALTERNATIVES

LOCATIONS OF POSSIBLE FREEWAY MANAGEMENT OPPORTUNITIES

-TORONTO-

HIGHWAY 403/401 COMBINATION VS Q.E.W./HIGHWAY 427 COMBINATION

SINGLE POINT DIVERSION SYSTEM

CORRIDOR MANAGEMENT SYSTEM:

BURNHAMTHORPE ROAD

HIGHWAY #5

THE QUEENSWAY

Q.E.W.

LAKESHORE ROAD

A P P E N D I X C

HIGHLIGHTS OF MONTREAL REVIEW

M O N T R E A L

- POSSIBLE FREEWAY MANAGEMENT OPPORTUNITIES -

- INDIVIDUAL BRIDGE SURVEILLANCE SYSTEMS (Maps in Appendix D)
- FREEWAY SURVEILLANCE AND CONTROL (Maps in Appendix G)
  - #15 AND #20 ALONG ST. LAWRENCE RIVER (No. 1 on Map on Page C-4)
  - VILLE MARIE EXPRESSWAY TO TUNNEL (No. 2 on Map on Page C-4)

- DRIVER INFORMATION AND ALTERNATIVE ROUTING (Maps in Appendix E)
  - SAINT LAWRENCE RIVER CROSSINGS FROM #15 AND #20 (No. 3 on Map on Page C-4)
    - PONT MERCIER (#138) (No. 3a on Map)
    - PONT CHAMPLAIN (No. 3b on Map)
    - PONT VICTORIA (No. 3c on Map)
    - PONT JACQUES CARTIER (No. 3d on Map)
    - PONT/TUNNEL LA FONTAINE (No. 3e on Map)
  - SOUTH/WEST CROSSING FROM DORION & #20 (No. 4 on Map on Page C-4)
    - PONT DE ILE AUX TOURTES (#40) (No. 4a on Map)
    - PONT TASCHEREAU & PONT GALIPEAULT (#20) (No. 4b on Map)
  - CROSSINGS FROM LAVAL (No. 5 on Map on Page C-4)
    - PONT LOUIS BISSON (#13, AUTOROUTE CHOMEDEY) (No. 5a on Map)
    - PONT LACHAPELLE (No. 5b on Map)
    - PONT MÉDÉRIC-MARTIN (#15, AUTOROUTE DES LAURENTIDES) (No. 5c on Map)
    - PONT VIAU (No. 5d on Map)
    - PONT PAPINEAU LE BLANC (No. 5e on Map)
    - PONT PIE IX (No. 5f on Map)
  - NORTH CROSSINGS TO CHARLEMAGNE (No. 6 on Map on Page C-4)
    - HIGHWAY #40 (No. 6a on Map)
    - PONT LE GARDEUR (#138) (No. 6b on Map)

- HOV PREFERENTIAL LANES AND RAMPS
  - PONT MERCIER (Map on Page F-2 and No. 3a on Page C-4)

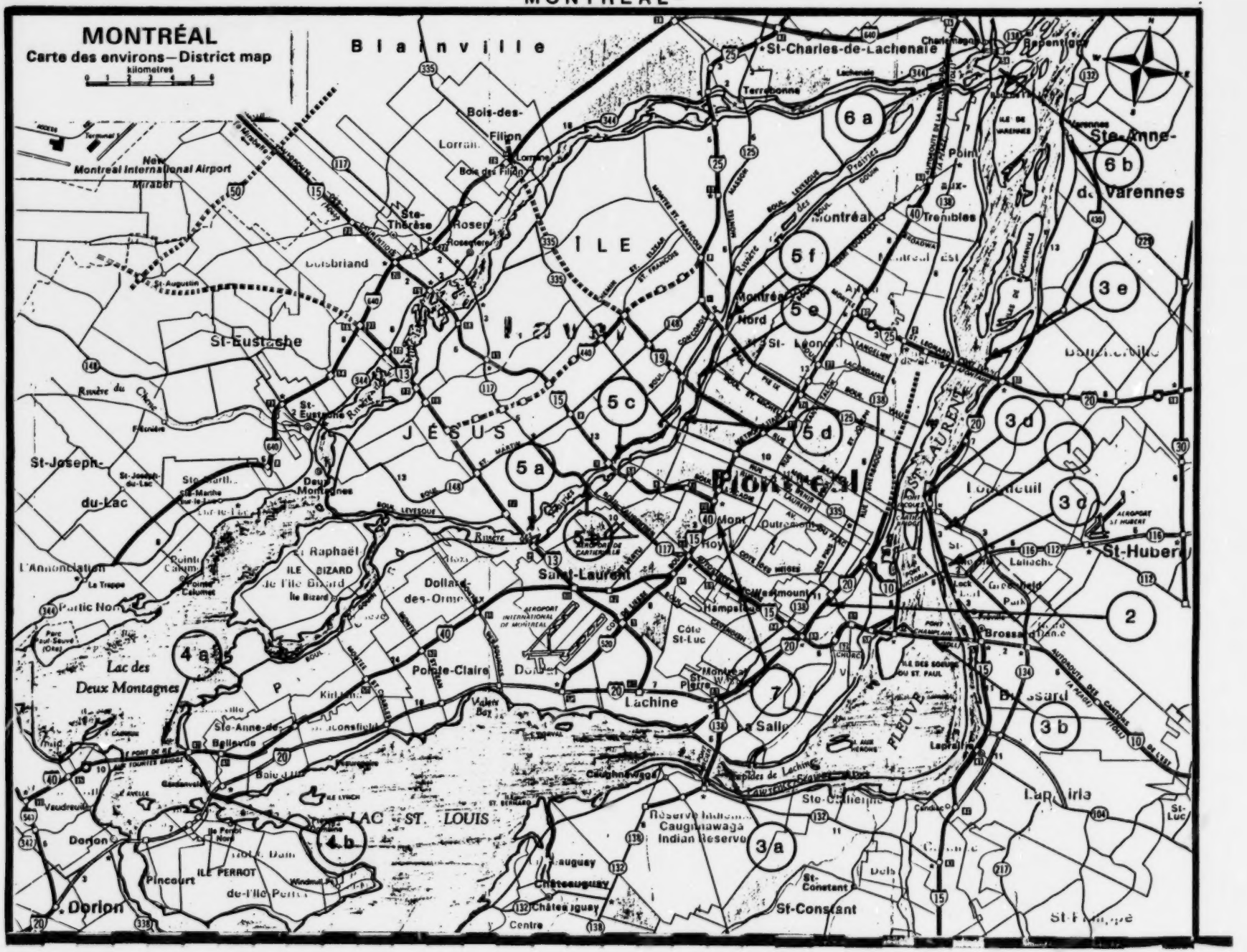
- FREEWAY INCIDENT MANAGEMENT TEAMS
  - POLICE/GOVERNMENT AGENCIES (MAINTENANCE, TRAFFIC, ETC.) TEAM
  - TOW TRUCKS
  - COURTESY PATROLS
  - EMERGENCY RESPONSE COORDINATION (AMBULANCES, FIRE TRUCKS, ETC.)

- CORRIDOR MANAGEMENT SYSTEM (No. 7 on Map on Page C-4)
  - METROPOLITAN EXPRESSWAY (#40) AND DECARIE EXPRESSWAY (#15) WITH SERVICE ROADS, INTERCHANGES, AND INTERSECTING ROADWAYS

- PRE-TRIP PLANNING
  - TRAFFIC INFORMATION REPORTING SYSTEM AT MAJOR DOWNTOWN EMPLOYMENT COMPLEXES
  - INFORMATION TO TV FOR VISUAL PRESENTATION OF TRAFFIC CONDITIONS

LOCATIONS OF POSSIBLE FREEWAY MANAGEMENT OPPORTUNITIES

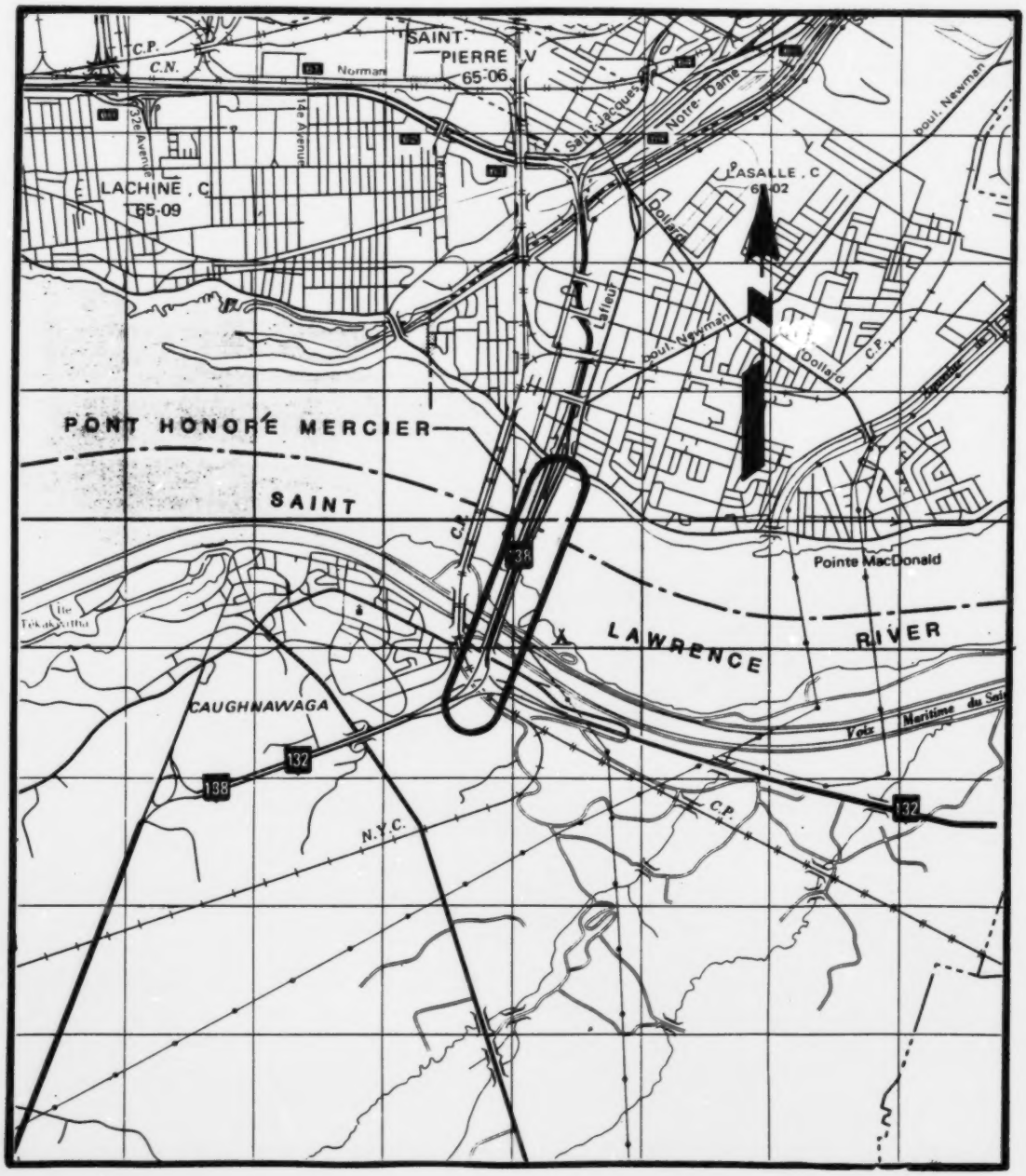
-MONTREAL-



APPENDIX D

INDIVIDUAL BRIDGE SURVEILLANCE SYSTEMS

PONT HONORÉ MERCIER
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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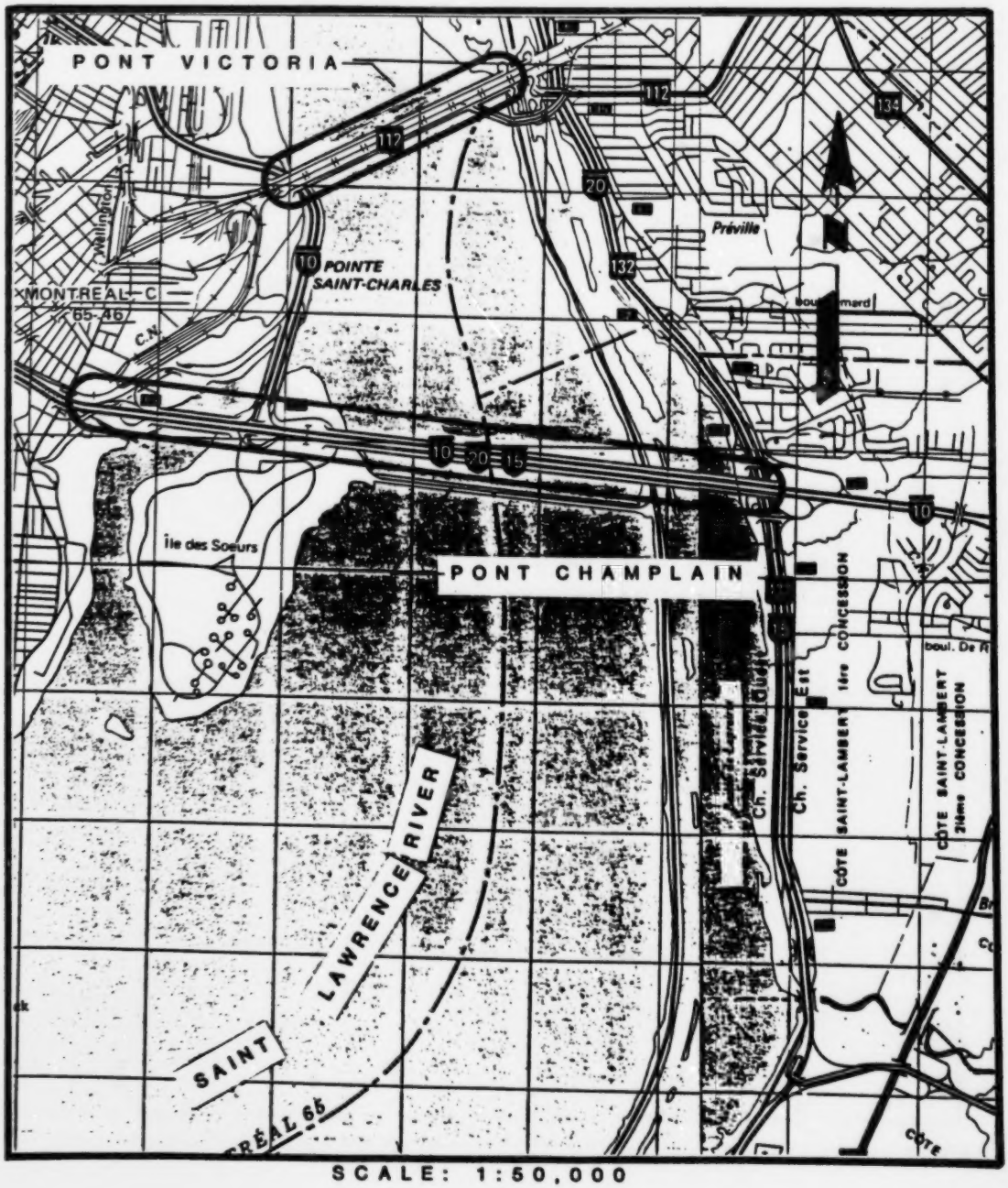
PONT CHAMPLAIN
BRIDGE SURVEILLANCE AND CONTROL SYSTEM
PONT VICTORIA
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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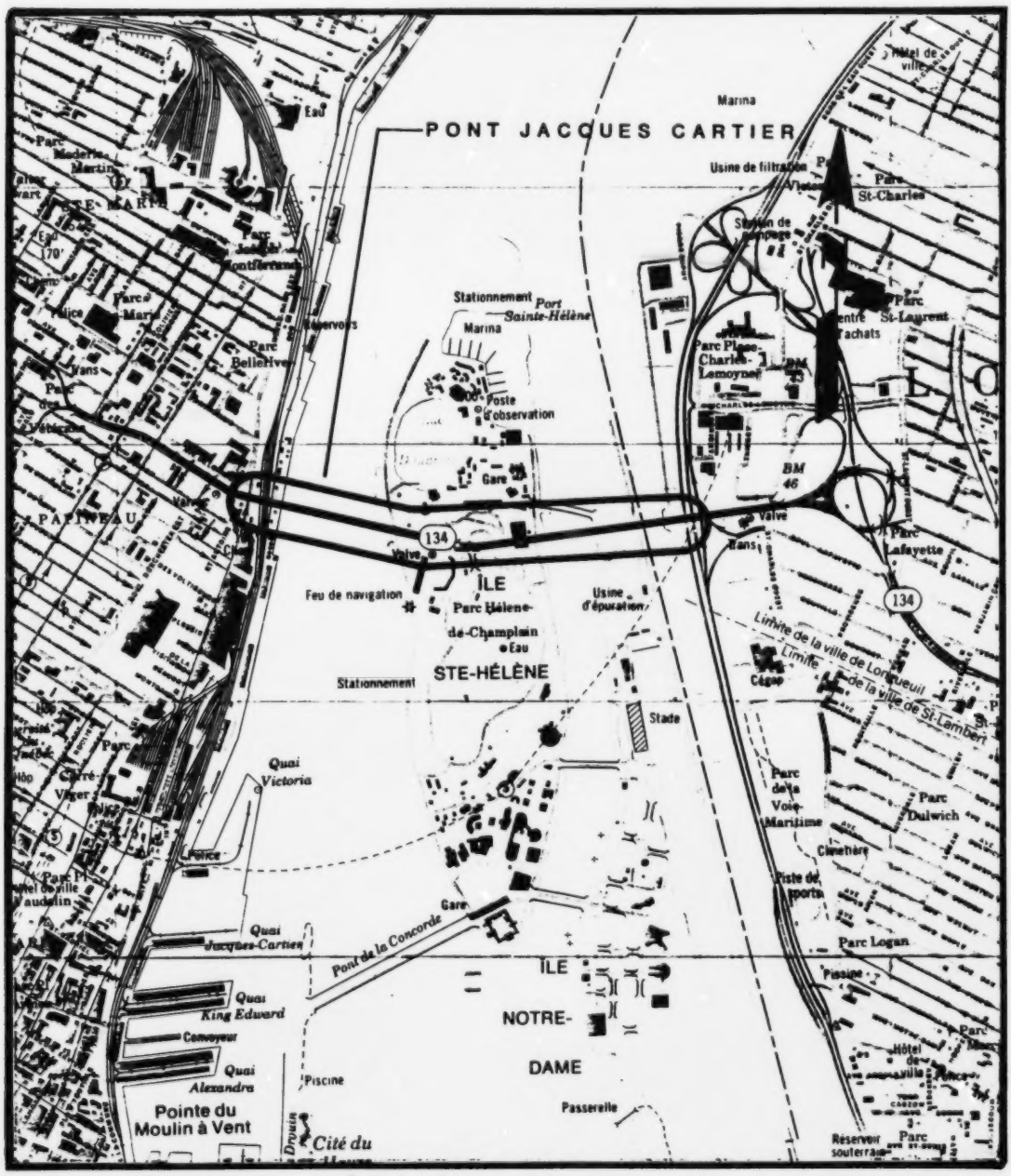
PONT JACQUES CARTIER
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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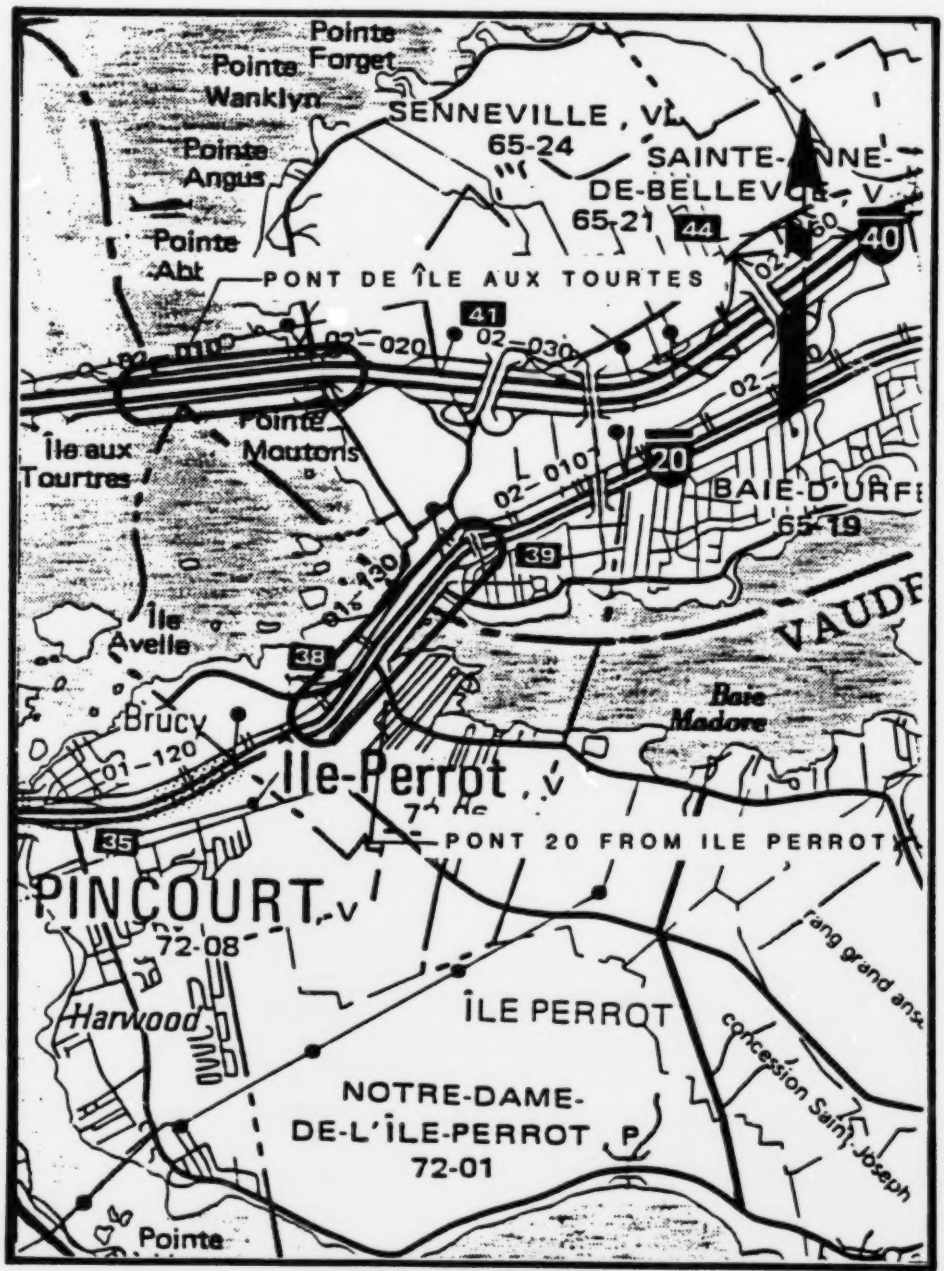
PONT TASCHEREAU AND PONT GALIPEAULT
BRIDGE SURVEILLANCE AND CONTROL SYSTEM

PONT DE ÎLE AUX TOURTES (#40)
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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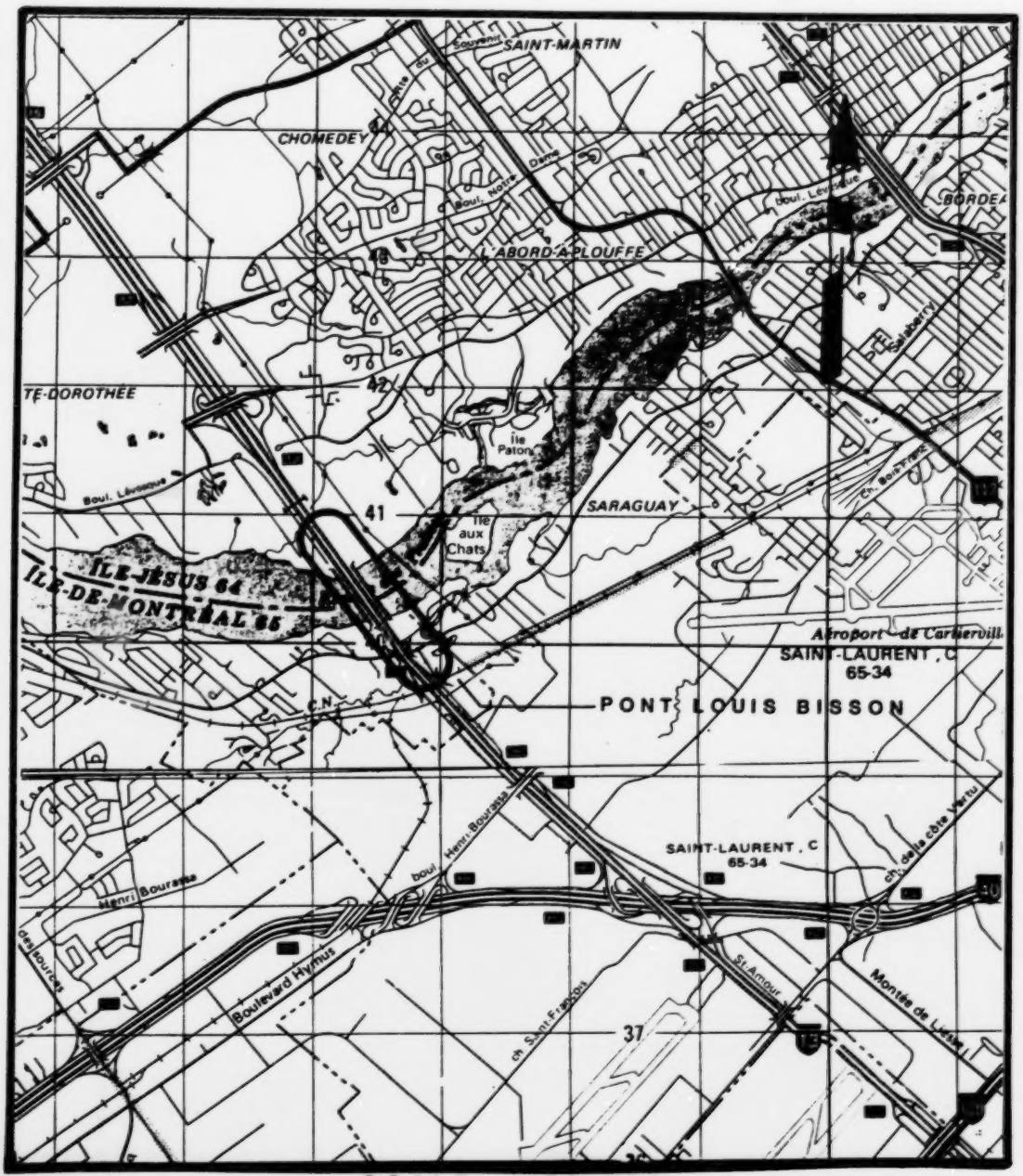
PONT LOUIS BISSON
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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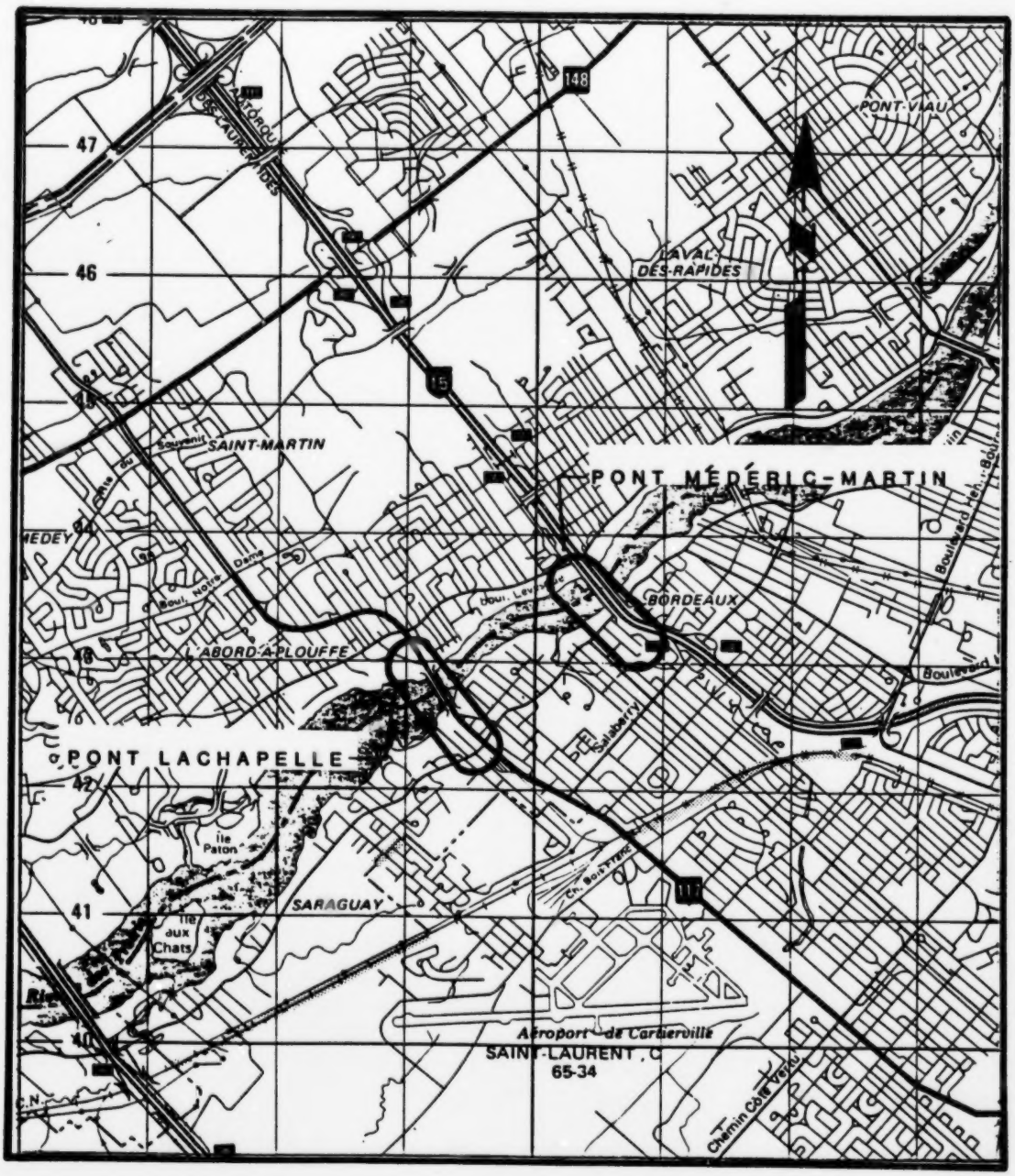
PONT MÉDÉRIC-MARTIN (#15)
BRIDGE SURVEILLANCE AND CONTROL SYSTEM

PONT LACHAPELLE
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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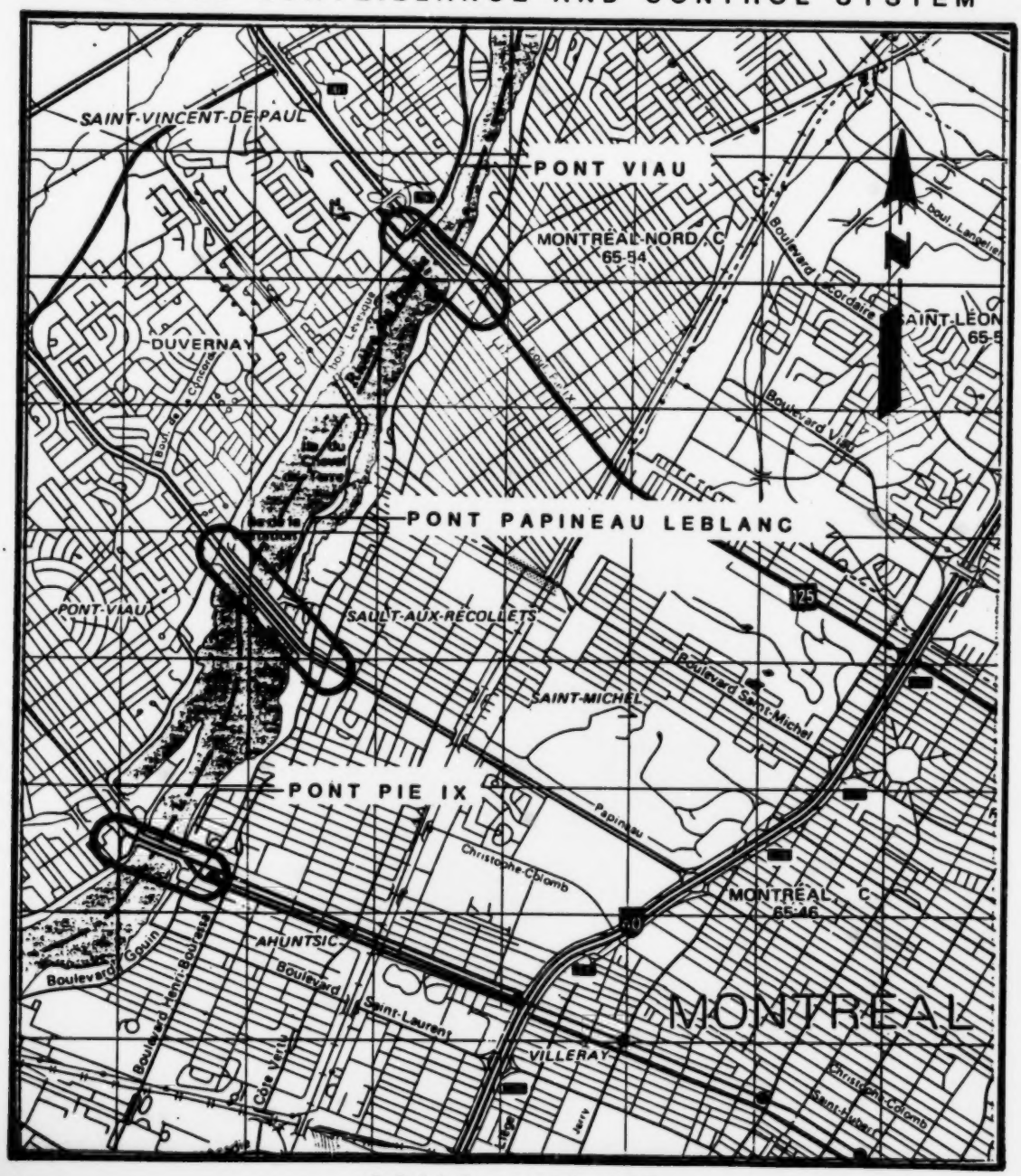
PONT VIAU
BRIDGE SURVEILLANCE AND CONTROL SYSTEM

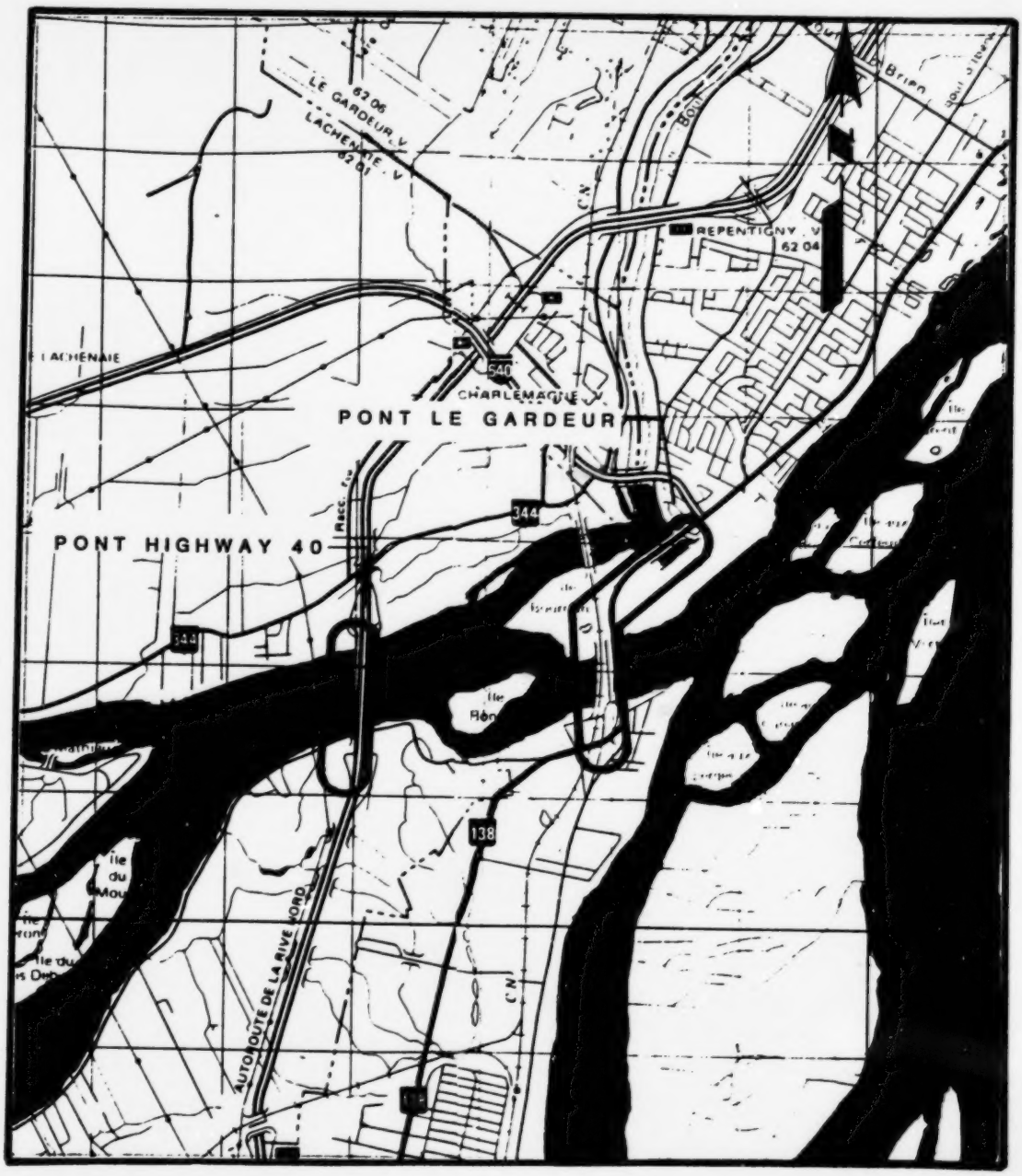
PONT PAPINEAU LEBLANC
BRIDGE SURVEILLANCE AND CONTROL SYSTEM

PONT PIE IX
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



PONT HIGHWAY 40
BRIDGE SURVEILLANCE AND CONTROL SYSTEM

PONT LE GARDEUR
BRIDGE SURVEILLANCE AND CONTROL SYSTEM



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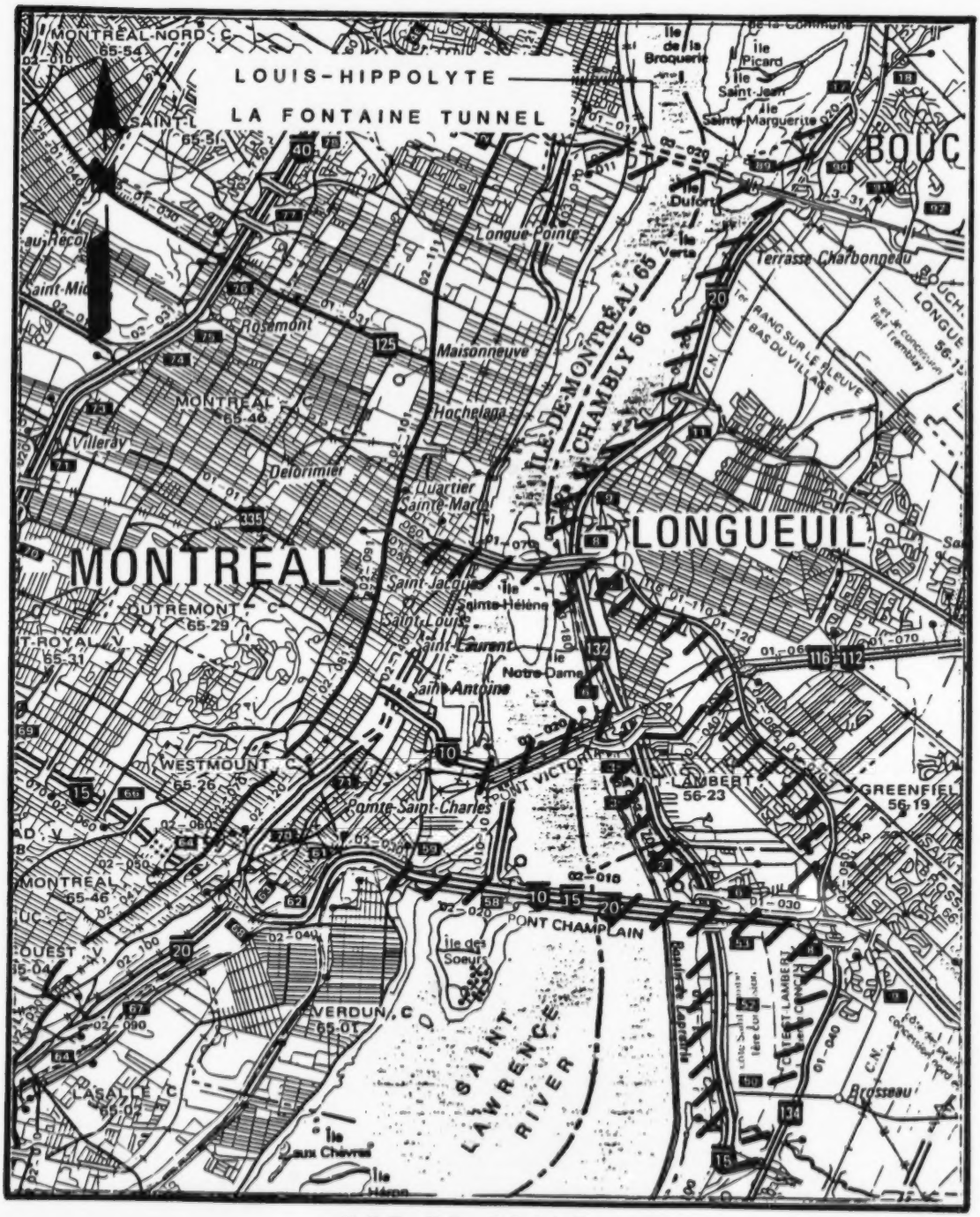
APPENDIX E

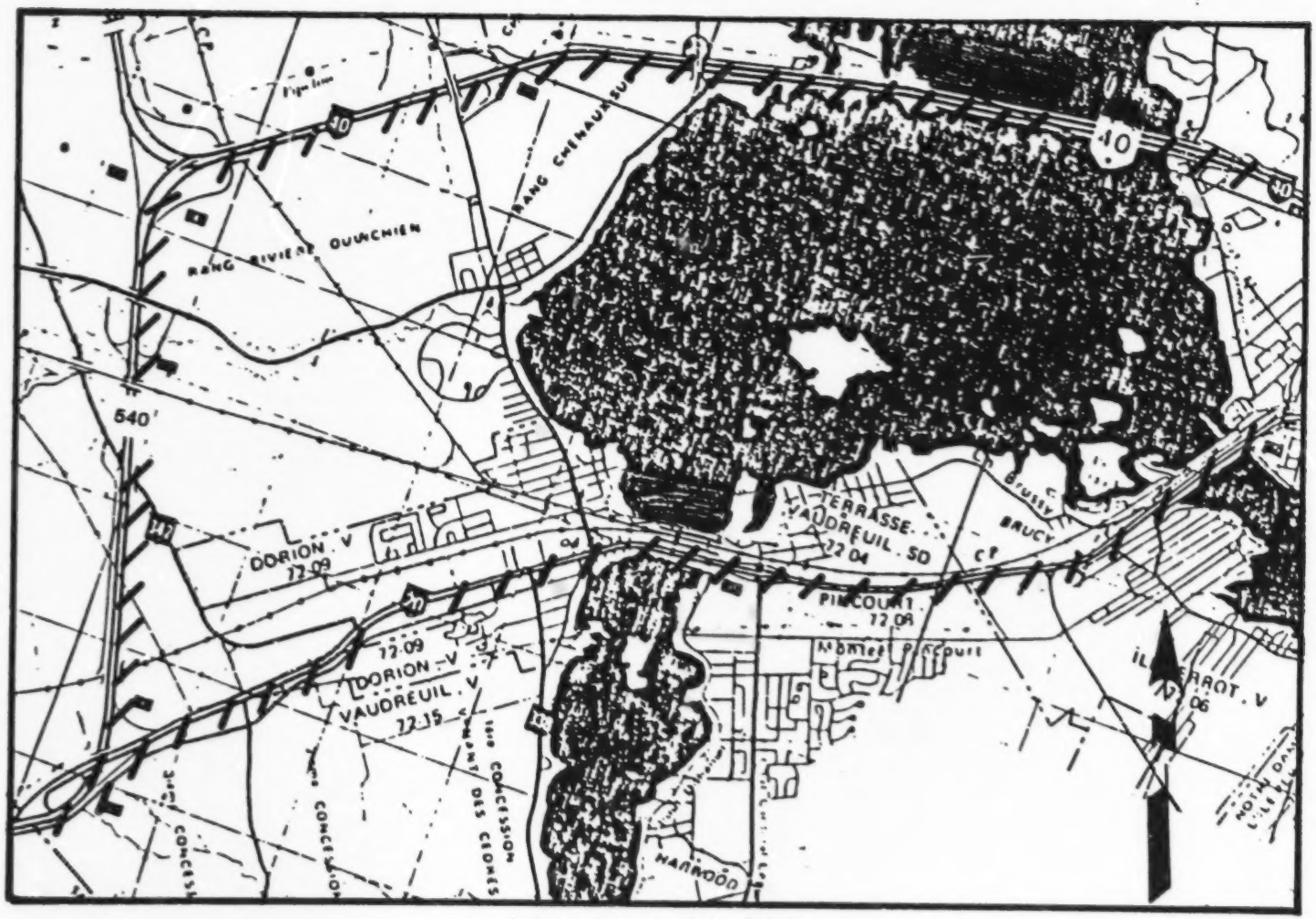
DRIVER INFORMATION AND DIVERSION SYSTEMS

SAINT LAWRENCE RIVER
DRIVER INFORMATION, ALTERNATIVE ROUTING, AND DIVERSION SYSTEM



DORION

DIVERSION AND DRIVER INFORMATION SYSTEM



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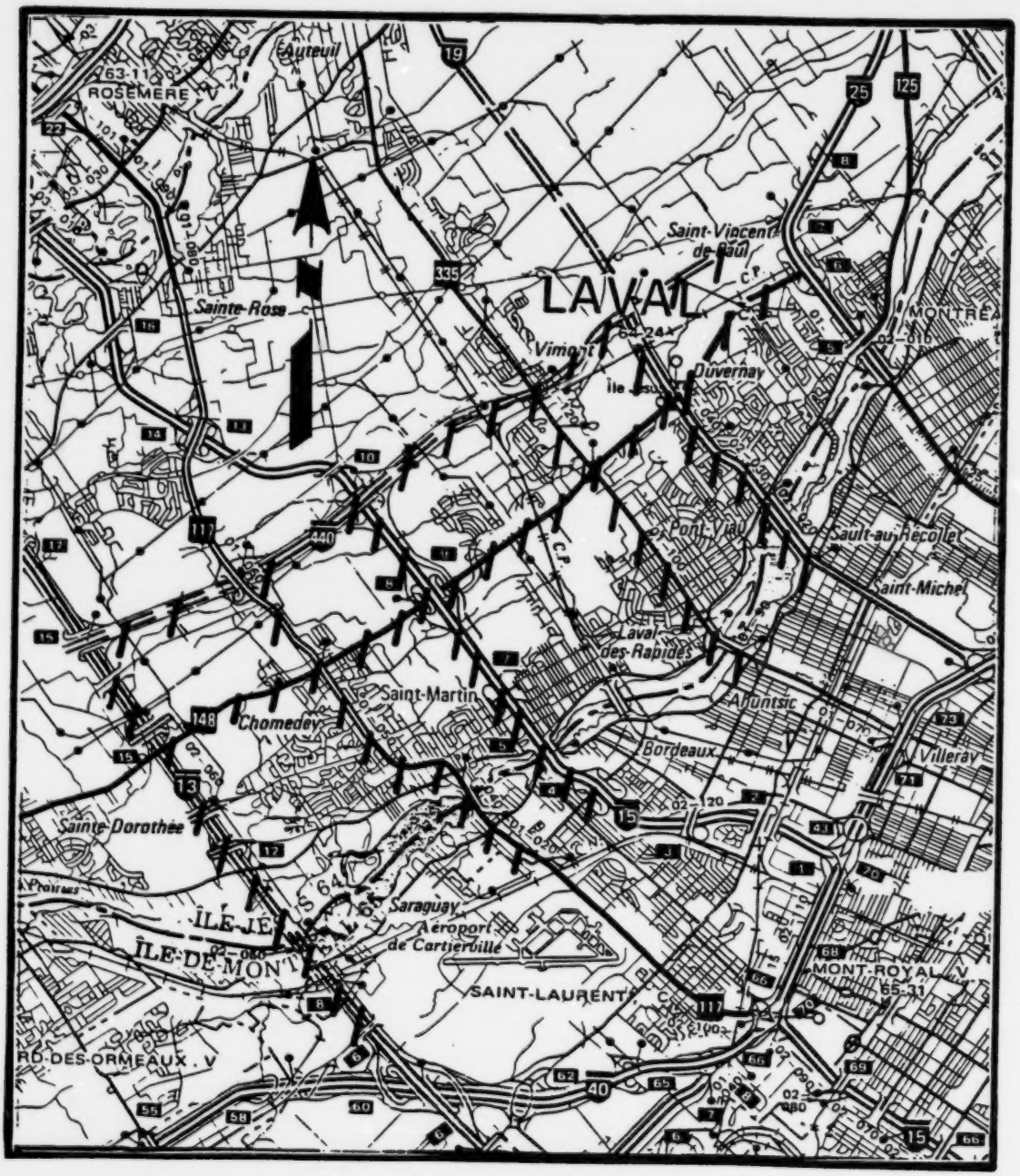
LAVAL

DRIVER INFORMATION, ALTERNATIVE ROUTING, AND DIVERSION SYSTEM



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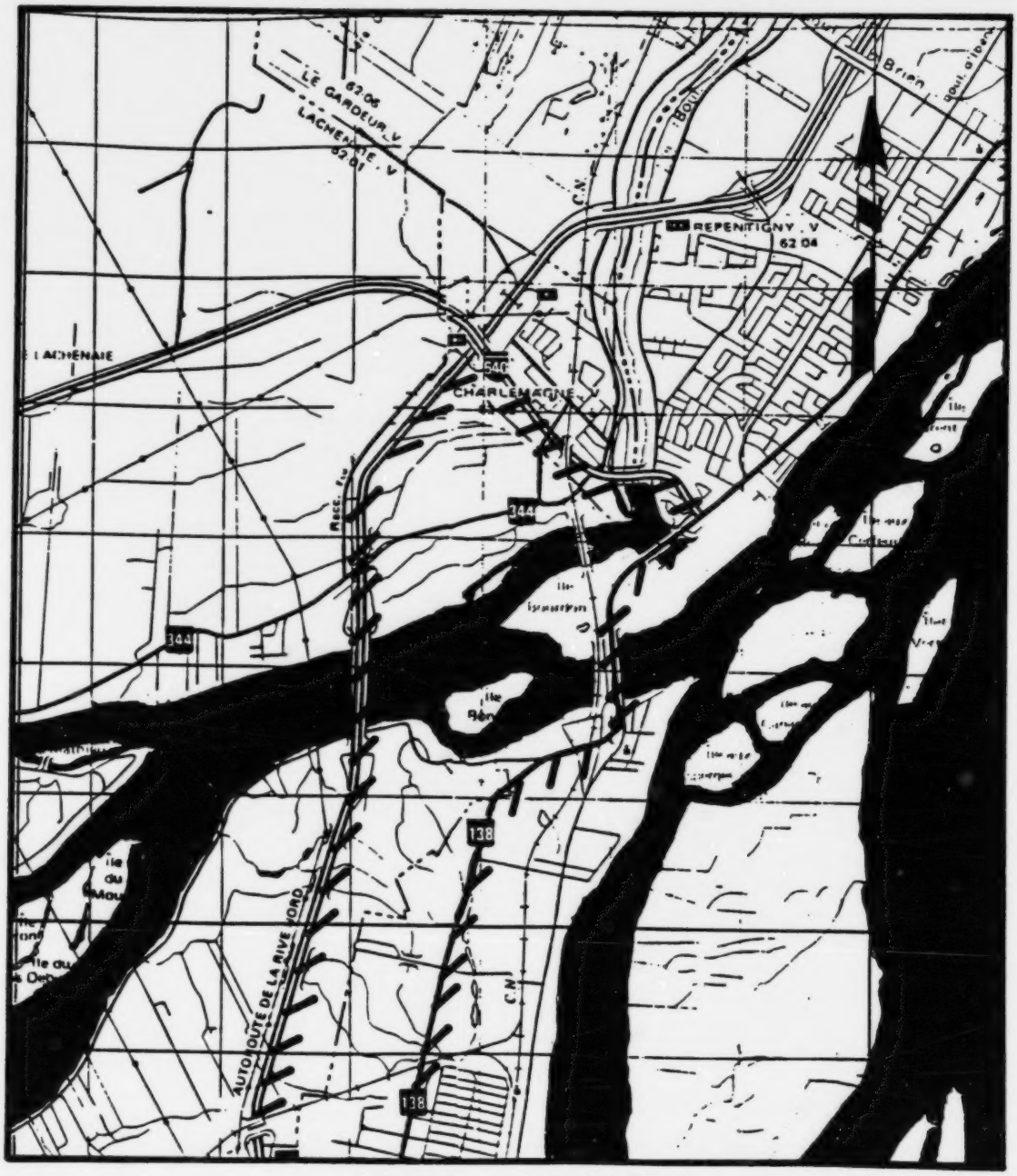
CHARLEMAGNE

DRIVER INFORMATION, ALTERNATIVE ROUTING, AND SINGLE POINT DIVERSION SYSTEM



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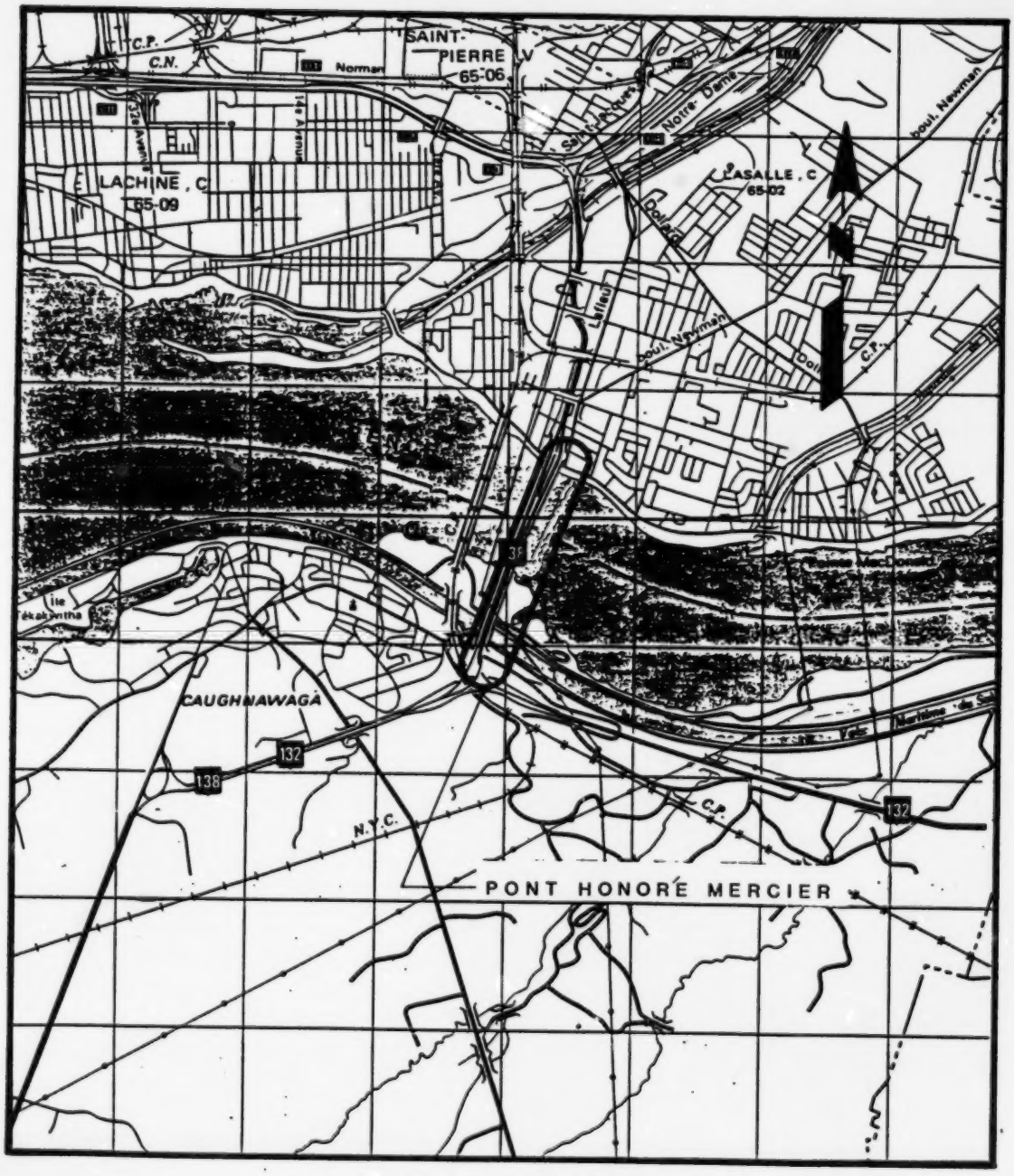
APPENDIX F

HOV SYSTEMS

PONT HONORÉ MERCIER
HOV PREFERENTIAL LANE OPERATION



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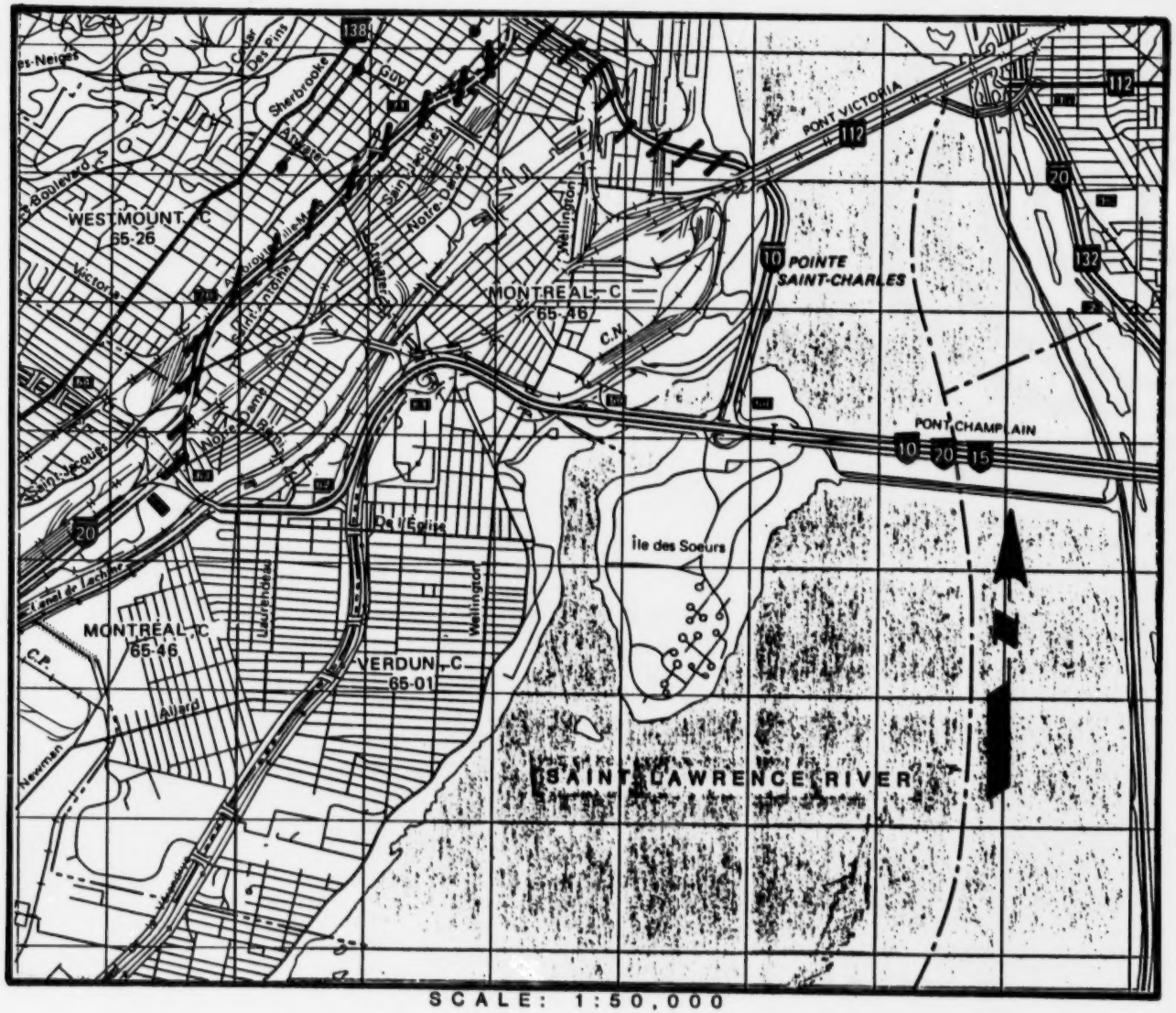
A P P E N D I X G

FREEWAY SURVEILLANCE & CONTROL SYSTEMS

VILLE MARIE EXPRESSWAY

SURVEILLANCE AND CONTROL SYSTEM



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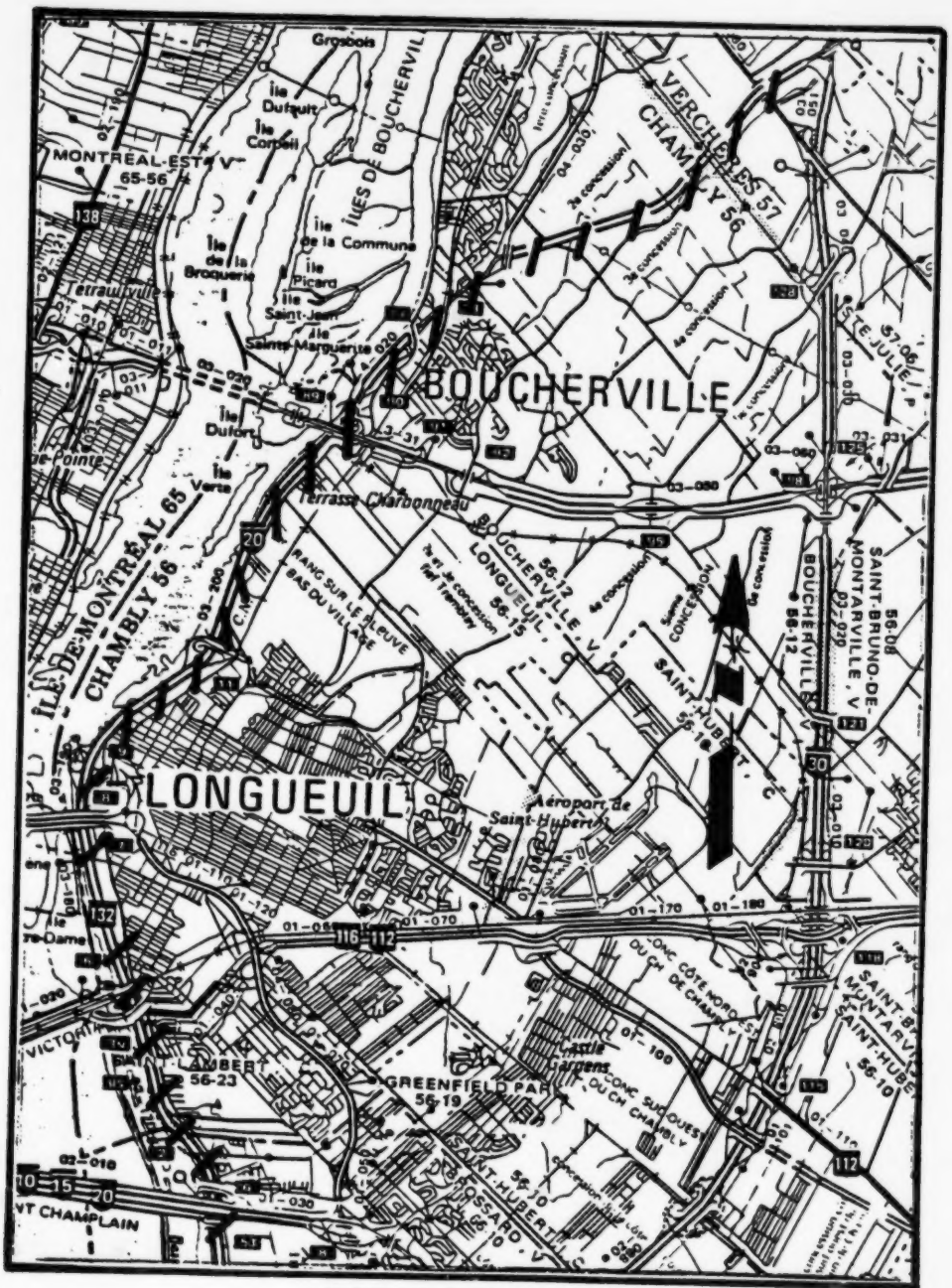
HIGHWAY 15 AND HIGHWAY 20
FREEWAY SURVEILLANCE AND CONTROL SYSTEM



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A P P E N D I X H

MEETINGS IN VANCOUVER

NOTICE OF MEETING

Date:	Monday, July 8, 1985
Time:	9:30 a.m.
Subject:	Freeway Management Systems
Location:	Boardroom Number 7, 5th Floor

Invitations To:

Ms. Catherine Hirou	Transport Canada
Mr. Jouko Parviainen	Consultant
Mr. Walter Dunn	Consultant
Mr. Allan Doherty	Energy Mines and Resources
Mr. Steve H. Reynolds	Senior Highway Planning Engineer
Mr. Bruce R. McKeown	Special Projects Engineer
Mr. Lorne Holowachuk	Traffic Engineer
Mr. Trevor Bagot	Electrical Engineer
Mr. Richard J. Voyer	Supervising Highway Planning Engineer
Mr. Richard A. James	Supervising Highway Planning Engineer
Mr. Gordon MacKay	Engineer-In-Training
Mr. Art Kastelein	Engineer-In-Training
Mr. Les M. Archer	Highway Planning Technician
Mr. J. Gregg Singer	Highway Design Engineer, Special Projects

AGENDA

FREEWAY MANAGEMENT SYSTEMS

1)	Review of the work plan of the Freeway Management System Project	J. Parviainen, W. Dunn
2)	Presentation of the Work Done to Date	J. Parviainen, W. Dunn
3)	Presentation of the Freeway Transportation Scene in the Vancouver Metropolitan Area	J. Parviainen, W. Dunn
4)	Break for Lunch	
5)	Review of the Situation in the Vancouver Metropolitan Area	S. H. Reynolds
	a) Annacis System	B. R. McKeown
	b) Burnaby Freeway	L. M. Holowachuk
6)	Discussion on Applicability of Each of the Freeway Management Techniques	ALL
7)	Discussion of Key Issues	ALL
8)	Other Business	ALL

FREEWAY MANAGEMENT SYSTEMS

Itinerary for Tuesday, July 9th, 1985 in Vancouver

Attendees:

Ms. Catherine Hirou	Transport Canada
Mr. Jouko Parviainen	Consultant
Mr. Walter Dunn	Consultant
Mr. Allan Doherty	Energy Mines and Resources
Mr. S. H. Reynolds	Senior Highway Planning Engineer
Mr. B. R. McKeown	Special Projects Engineer
Mr. L. M. Holowachuk	Traffic Engineer
Mr. L. Paulson	Regional Approving Officer (after 3:00 p.m.)

8:05 - 8:30 a.m.	Victoria to Vancouver (Air BC)
8:30 a.m.	Meet at Vancouver Airport, Arrivals Level - Messrs. S. H. Reynolds and B. R. McKeown have Tilden Cars to Drive the Participants to the Annacis Project
9:00 a.m.	Arrive at Annacis South Tower for Annacis Tour
12:30 p.m.	Lunch
1:30 p.m.	Messrs. B. R. McKeown and L. M. Holowachuk to Attend a Meeting in Burnaby Mr. S. H. Reynolds and Others to Tour Highway 1 in Burnaby
3:00 p.m.	Regroup at the Regional Office in Burnaby Mr. Lloyd Paulson to Join Group at This Time
3:00 - 5:30 p.m.	Tour of Highway 1 in Burnaby Under Peak Conditions

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A P P E N D I X I

ANNACIS FREEWAY

April 1985

Background Information

ANNACIS CROSSING PROJECT

Construction of the Annacis Crossing of the Fraser River and support highway system is proceeding on schedule for completion by the end of August 1986. To date, approximately $210,000,000 has been expended.

Main River Crossing

The main span contract was awarded in March 1984. This contract requires construction of a cable stayed structure, with a main span of 465 m, side spans of 182.75 m, and two transitional spans of 50 m. The work includes construction of the two main towers, four additional piers, fabrication and erection of the cable-deck system, deck panels, and deck overlay.

All foundation work was completed by September 1984. The south main tower has reached its full height of 153 m. The north main tower will reach full height by June 1985. Erection of the bridge deck recently commenced on the south side and will commence on the north side in May 1985. Construction will proceed from both sides with closure in the spring of 1986. The bridge will be opened for use at the end of August 1986.

Construction of the approach structures north and south of the river are proceeding very well. Three contracts have been awarded for construction of the north approach and one contract has been awarded for construction of the south approach. All approach structure work will be completed by January 1986.

Other Structures

Construction is underway on a swing bridge crossing of Annacis Channel and on the realignment of the south end of the Queensborough Bridge. In March, the Ministry awarded a contract for the construction of a five lane highway crossing of Annacis Channel.

In addition to the above, 16 minor structures are required. To date, designs have been completed on six of these and they are either under construction or in the tender-award phase. The remaining ten structures are proceeding through design with tendering and construction contract awards to follow during 1985.

Highway Construction

For the highway south of the main river crossing, construction material supply and grading are well advanced. Major contracts awarded over the last year include:

- two dredging contracts (total of 1,850,000 m^3 of sand)
- one soil preparation contract
- three grading contracts (total of 10.4 kilometres of highway and rail grade)

In addition, a number of day labour projects are underway. This work will complete all railway relocation grade work and highway grade construction south to Highway 10. An additional grading contract will be awarded by early summer to complete highway grading south to Highway 99.

Paving contracts are being prepared and the first will be awarded during the summer of 1985.

Highway Construction (Con't)

North of the main river crossing, dredging and grading work is also well advanced. Major contracts awarded over the last year include:

- one dredging contract (800,000 m^3 of sand)
- five soil preparation contracts
- three grading contracts (total of 9.0 kilometres of highway and rail grade)
- two paving contracts

Again, a number of day labour projects are underway. Rail relocation projects in the Queensborough area and on Annacis Island have been completed. Additional paving contracts are being prepared.

Connections South of the River

Delta Municipality and the Ministry have reached agreement on road connections. When opened in late August 1986 the Annacis System will have connections to River Road, 112th Street, 84th Avenue, 72nd Avenue, 64th Avenue, and Highway 10. In 1987 the Annacis Highway will be extended to Highway 99.

Design work and right-of-way acquisitions are proceeding and road construction contracts will be awarded by early summer 1985. The Ministry will also carry out improvements to Scott Road.

North End of the Queensborough Bridge

Construction, by contract, continues on roadway improvements at the north end of the Queensborough Bridge. This work, due for completion by October 1985, will tie in the new Marine Way route. In future years, additional bridgehead improvements will be required but the City of New Westminster and the Ministry have not as yet reached agreement.

East-West Route Through Richmond

Design and right-of-way acquisition is proceeding for the new four lane freeway through Richmond. This facility will link the Annacis System to Knight Street and Highway 99 as well as extending into the Richmond town center area. The construction program is aimed at completion by the spring of 1988. The Ministry is expediting this project and the first construction contract has been awarded.

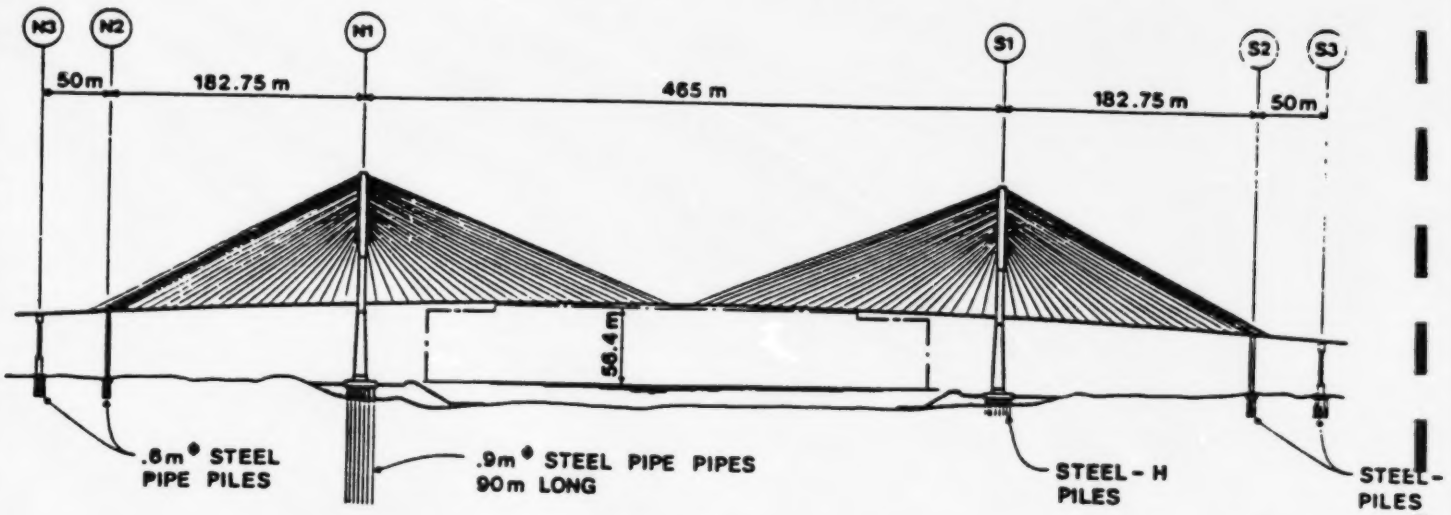
Job Creation

Non Ministry direct employment on current work would be approximately 1100. Of this total, 950 are employed on site with 150 British Columbia off site jobs such as steel fabrication. Approximately 200 Ministry staff are working on this major project.

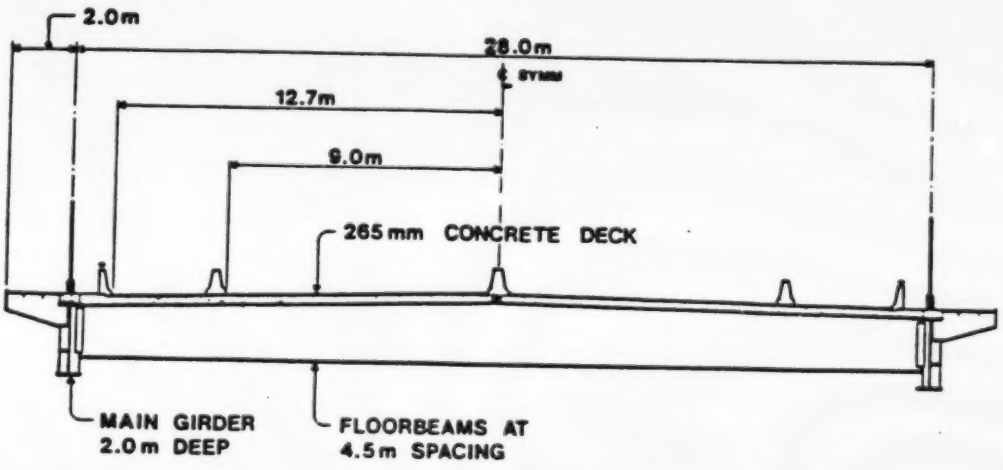
Project Cost

The total cost estimate for the Annacis Highway project is $350,000,000. The Delta municipal road connections, North End of the Queensborough Bridge, and Richmond East-West Road projects have a total cost estimate of $95,000,000.

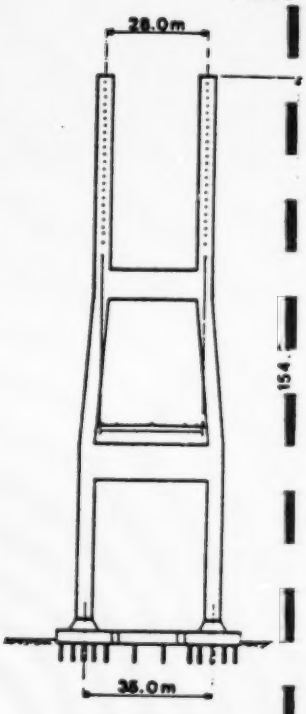
ANNACIS ISLAND CABLE STAYED BRIDGE



ELEVATION



TYPICAL CROSS SECTION



TOWER SECTION

GENERAL INFORMATION

Owner:	Ministry of Transportation and Highways of British Columbia.
Design Engineers:	CBA-Buckland and Taylor, Vancouver.
General Contractor:	A Joint Venture of P.C.L.-Paschen-Pike.
Capital Cost:	Canadian $45.7 million, excluding approaches.
Planned Completion Date:	September 1986.

BRIDGE DESCRIPTION

Type of Bridge:	Modified Fan Cable Stayed Bridge.
Spans:	50m, 182.75m, 465m, 182.75m, 50m.
Tower Height:	154.3m above top of pilecap.
Midspan Shipping Clearance:	58.4m above High Water.
Traffic Capacity:	Initially 4 lanes of highway traffic.
Design Capacity:	6 lanes of highway traffic or 4 lanes plus 2 tracks for ALRT.

SUPERSTRUCTURE

The superstructure comprises a structural steel skeleton consisting of constant depth twin I beams and transverse floorbeams, which supports a composite precast concrete deck with a cast in place concrete overlay.

I beams:	2.1m deep by 18m long typically. Splices are bolted.
Floorbeams:	Tapered 1.6m to 1.8m deep by 27.2m long typical.
Floorbeam spacing:	4.5m typical.
Quantity of Structural Steel:	5,600 tonnes.
Grade of Structural Steel:	350 AT Category 2. 350MPa Yield Stress Atmospheric Corrosion Resistant Steel having a guaranteed Charpy Impact Strength of 27 Joules at -20 C.
Precast Deck Panels:	13.5m x 4.0m x 215mm typical - weight 35 tonnes approx.
Precast Concrete Strength:	55 MPa @ 56 days.
Overlay Concrete Strength:	55 MPa @ 56 days.

CABLES

Cables are Long Lay Galvanized Bridge Strand sheathed with black polyethylene. Every cable has a zinc filled cast steel socket at both ends. Cables terminate at tie beams in the towers where provision is made for jacking and adjustment.

Number of Cables:	192 main cables, 8 tie down cables.
Cable lengths:	49.5m to 237.5m.
Cable diameters:	80mm to 130mm.
Wire:	7mm diameter galvanized, U.T.S. 1520 MPa.
Cable Assembly Weights:	2 tonnes to 24 tonnes.
Total Cable Weight:	1505 tonnes (excluding sockets).
Total Socket Weight:	193 tonnes.

TOWERS AND BENTS (including Pilecaps)

The towers and bents are reinforced concrete structures with provision for ductile behaviour in earthquake.

Reinforced Concrete Strength:	35 MPa.
Reinforcing Steel:	400 MPa.
Quantity of Concrete:	8586 Cu. Metres in two towers. 3006 Cu. Metres in four bents.
Quantity of Reinforcing Steel:	2050 tonnes in two towers, including pilecaps. 550 tonnes in four bents, including pilecaps.

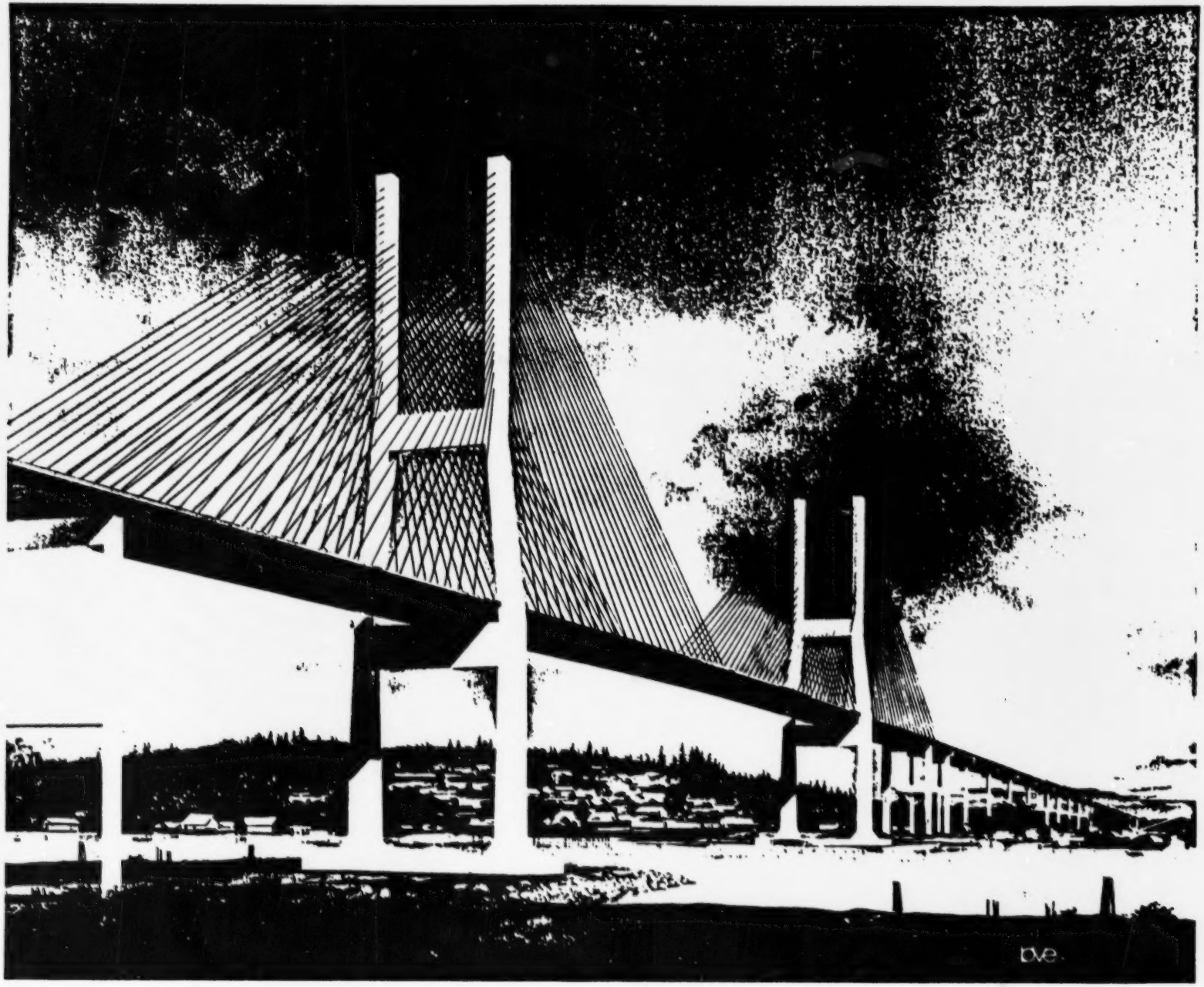
FOUNDATIONS

All of the foundations rest on steel piles. In addition, densification piles were used in the upper sands around piers N1, N2 and N3 to eliminate the possibility of liquefaction during earthquake.

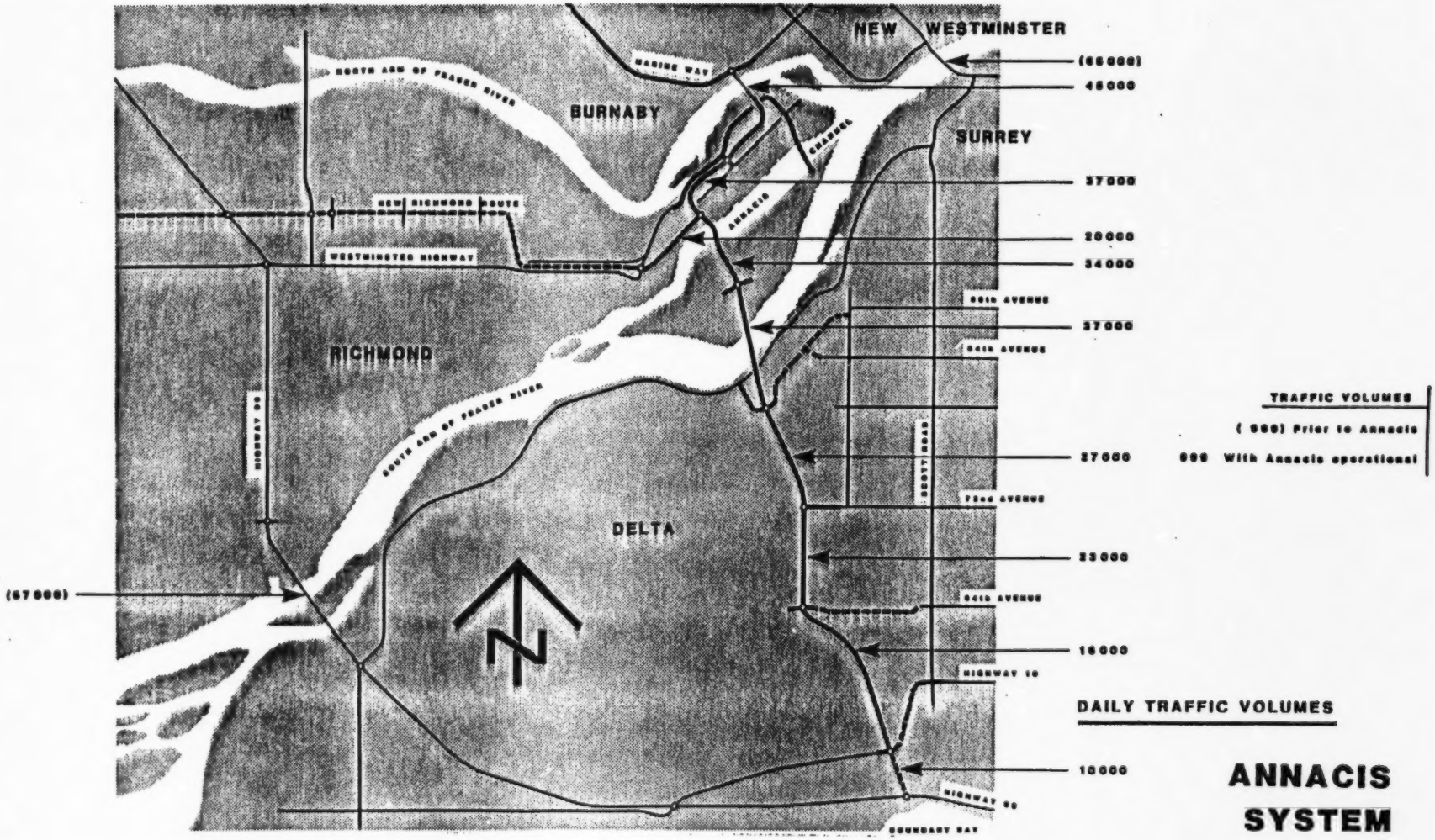
Pier	Pile Type	No.	Length
S3	HP360 x 152	64	13 - 16m
S2	HP360 x 152	42	12 - 15m
S1	HP360 x 152	339	16 - 23m
N1	9150D x 19 Pipe piles driven open ended, concrete filled	72	78 - 87m
N2	6100D x 12.5 Pipe piles driven closed ended, concrete filled	28	21m
N3	" " " " "	40	17 - 21m

SHIP IMPACT

Piers S1 and N1 have protective surrounds, designed to withstand the impact of a 60,000 DWT vessel travelling at 12 knots.



ANNACIS BRIDGE


NEW WESTMINSTER
BURNABY
SURREY
RICHMOND
DELTA
NORTH ARM OF FRASER RIVER
SOUTH ARM OF FRASER RIVER
MARINE WAY
ANNACIS CHANNEL
ANNACIS
WESTMINSTER HIGHWAY
HIGHWAY 99
SCOTT ROAD
64th AVENUE
72nd AVENUE
HIGHWAY 10
BOUNDARY BAY
(65 000)
45 000
37 000
20 000
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37 000
27 000
23 000
16 000
10 000
(67 000)
TRAFFIC VOLUMES
(000) Prior to Annacis
000 With Annacis operational
DAILY TRAFFIC VOLUMES
ANNACIS SYSTEM

CA1
DTC8D1
85
I765TM
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(MM)

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Freeway Management Systems for Transportation Efficiency and Energy Conservation - series includes the following reports:

* Summary of North American and European Projects	TP 6640E
* Bibliography of Key References	TP 6639E
* Practical Planning Guide for Traffic Engineers	TP 6220E
* Overview	TP 6343E

Systèmes de gestion d'autoroutes visant à maximiser les économies d'énergie et l'efficacité des transports routiers -

les documents suivants de cette série sont disponsibles en francais:

* Guide de planification pour ingénieurs en circulation	TP 6220F
* Aperçu général	TP 6343F

These publications are available from:

Transportation Development Centre
Transport Canada
Complexe Guy Favreau
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West Tower, Suite 601
Montreal, Quebec
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